An exciting hobby.... for everyone

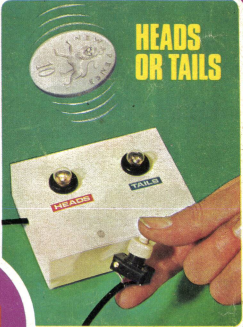
everyday electronics

AUG 74

FOR .40

EXPERIMENT IN HEADPHONE STEREO

Australia 40c
New Zealand 45c
South Africa 40c
Malaysia $1.80
Sweden Kr.3.50
Malta 22c5



HEADS OR TAILS

EASY TO BUILD PROJECTS

PLUS!

- THEORY
- PRACTICE
- POPULAR FEATURES

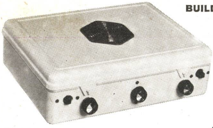
Electronics made easy!

RADIATION MONITOR

NEW EDU-KIT MAJOR

COMPLETELY SOLDERLESS ELECTRONIC CONSTRUCTION KIT.

BUILD THESE PROJECTS WITHOUT SOLDERING IRON OR SOLDER.



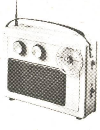
★ 4 Transistor Earpiece Radio ★ Signal Tracer ★ Signal Injector ★ Transistor Tester NPN-PNP ★ 4 Transistor Push Pull Amplifier ★ 5 Transistor Push Pull Amplifier ★ 7 Transistor Loudspeaker Radio MW/LW ★ 5 Transistor Short Wave Radio ★ Electronic Metronome ★ Electronic Noise Generator ★ Batteryless Crystal Radio ★ One Transistor Radio ★ 2 Transistor Regenerative Radio ★ 3 Transistor Regenerative Radio ★ Audible Continuity Tester ★ Sensitive Pre-Amplifier.

★ 24 Resistors ★ 21 Capacitors ★ 10 Transistors ★ 3¼ loudspeaker ★ Earpiece ★ Mica Baseboard ★ 3 12-way connectors ★ 2 Volume controls ★ 2 Slider Switches ★ 1 Tuning Condenser ★ 3 Knobs ★ Ready Wound MW/LW/SW Coils ★ Ferrite Rod ★ 6½ yards of wire ★ 1 yard of sleeving, etc. ★Parts price list and plans **50p** (FREE with parts).

Total Building Costs
£7·23 P P & Ins. 44p.
(Overseas P & P £1·85p.)
(+ 10% VAT 72p)

NEW ROAMER NINE

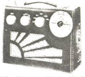
WITH V.H.F. INCLUDING AIRCRAFT



Nine Transistors, 9 Tunable wavebands as Roamer Ten, built in ferrite rod aerial for MW/LW. Retractable chrome plated telescopic aerial for VHF and SW. Push Pull output using 600 mw transistors. 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange control. Attractive all white case with red grille and carrying strap. Size 9½″ × 7″ × 2¾″ approx. Parts Price list and Plans 30p (FREE with parts)

Total Building Costs **£6·95** P P & Ins. 44p.
(Overseas P & P £1·85p)
(+ 10% VAT 69p)

ROAMER TEN



with VHF including aircraft. 10 Transistors. Latest 4″ 2 watt Ferrite Magnet Loudspeakers, 9 Tunable Wavebands. MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band, Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600 mw Transistors. Car Aerial and Tape Recording Sockets. 10 Transistors plus 3 Diodes. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9″ × 7″ × 4″. Easy to follow instructions and diagrams. Parts price list and plans **30p** (FREE with parts).

Total building costs **£8·50** P. P. & Ins. 52p
(Overseas P. & P. £1·85)
(+ 10% VAT 85p)

NEW EVERYDAY SERIES

Build this exciting New series of designs

E.V. 5 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9″ × 5¼″ × 2¾″ approx.
Parts price list and Plans 15p. Free with parts.

Total Building Costs **£2·95** P P & Ins. 30p
(Overseas P & P £1·25p)
(+ 10% VAT 29p)

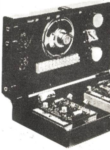
E.V. 6 Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3″ loudspeaker, etc., MW/LW coverage. Push Pull output. Parts price list and Plans 15p. Free with parts.

Total Building Costs **£3·60** P & P Ins. 30p
(Overseas P & P £1·25p)
(+ 10% VAT 36p)

E.V. 7 Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3″ loudspeaker. Parts price list and easy build plans 20p. Free with parts.

Total Building Costs **£4·08** P P & Ins. 31p
(Overseas P & P £1·85)
(+ 10% VAT 40p)

"EDU-KIT"



Build Radios, Amplifiers, etc. from easy stage diagrams. Five units including master unit to construct

Components include:
Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine 3″ Tone Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ½″ Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.
Parts price list and plans 25p (FREE with parts).

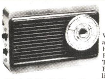
Total Building Costs **£5·50** P P & Ins. 33p
(Overseas P & P £1·85)
(+ 10% VAT 55p)

POCKET FIVE

3 Tunable wavebands M.W./L.W. and Trawler Band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive Black and Gold Case. Size 5½″ × 1½″ × 3½″ approx. Plans and parts price list **15p.** (Free with parts).

Total Building Costs **£2·50** P P & Ins. 26p
(Overseas P &P 1·25p)
(+ 10% VAT 25p)

TRANSONA FIVE



Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial.
Plans and parts price list **15p** (Free with parts).

Total Building Costs **£2·75** P P & Ins. 26p
(Overseas P & P 1·25p)
(+ 10% VAT 27p)

ROAMER EIGHT Mk 1

NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Latest 4″ 2 watt Ferrite Magnet Loudspeakers. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and plans **25p** (FREE with parts).

Total Building Costs **£6·98** P P & Ins. 47p
(Overseas P. & P. £1·85)
(+ 10% VAT 69p)

ROAMER SIX

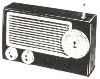
Case and looks as Trans-Eight

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3, Trawler band plus an Extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5¼ × 2¾in. approx. Plans and parts price list **25p** (FREE with parts).

Total Building Costs **£3·98** P P & Ins. 31p
(Overseas P. & P. £1·85)
+ 10% VAT 39p)

TRANS EIGHT

8 TRANSISTORS and 3 DIODES



6 Tunable Wavebands; MW, LW. SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5¼ × 2¾in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans **25p** (FREE with parts).

Total Building Costs **£4·48** P P & Ins. 33p
(Overseas P & P £1·25)
(+ 10% V.A.T. 44p)

- **Callers side entrance "Lavells" Shop**
- **Open 10-1, 2.30-4.30 Mon.–Fri.—9-12 Sat.**

RADIO EXCHANGE CO

61a HIGH STREET, BEDFORD, MK40 1SA **Tel. 0234 52367**
Reg. no. 788372

I enclose £............ for...

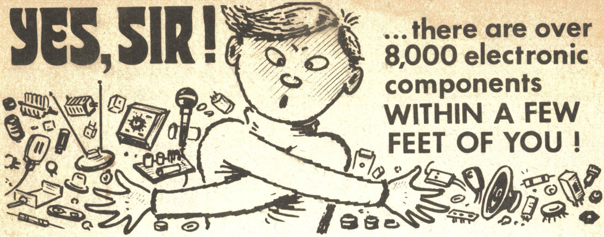
Name...

Address ....

....

(Dept E.E. 8)

HOME RADIO (Components) LTD, Dept. EE, 234-240 London Road, Mitcham, CR4 3HD. Phone 01-648 8422



YES, SIR!

... there are over 8,000 electronic components WITHIN A FEW FEET OF YOU !

That is, assuming you are on the telephone, and that you don't keep it at the top of the garden!

If you're not on the phone, the distance is between you and your nearest post box

HOME RADIO (COMPONENTS)
JACK PLUGS AND JACK SOCKETS
STANDARD JACK PLUGS - SCREENED
SPECIAL JACK PLUGS
HOME RADIO (COMPONENTS) LTD
JACK PLUGS AND JACK SOCKETS - Continued
JACK PLUGS AND SOCKETS
JACK SOCKET ACCESSORIES
98
99

240 pages
Over 8,000 items
Nearly 2,000 pictures

The first thing you need, to enable you to get all your components quickly, easily, economically, is a copy of the 240 page Home Radio Components Catalogue. Apart from listing the vast range of lines we stock, the catalogue contains details of our popular Credit Account Service and many other items of useful information. For example, as there are several ways of ordering, several ways of paying and several ways of delivery, the pros and cons of all the methods are clearly set out in the catalogue.

We have the reputation of providing the best-organised service ever offered to buyers of electronic components. Of course, to make good use of this service you need the catalogue. It costs 55 pence, plus 22p post and packing, and when you receive your copy you'll agree it's the best investment you've made for a long time. Moreover with the catalogue we give you 10 Vouchers each worth 5 pence against orders, an up-to-date Price List and a Bookmark with a useful list of technical abbreviations.

Send off the coupon today. It's your first step to solving your component buying problems.

Only 55p. plus 22p POST AND PACKING

POST THIS COUPON
with cheque or P.O. for 77p.

The price of 77p applies only to customers in the U.K. and to BFPO addresses

Name ______________________________

Address ______________________________

____

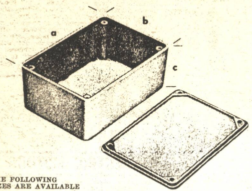
HOME RADIO (Components) LTD. (Regn. No. London 912966)
Dept. EE, 234-240 London Road, Mitcham CR4 3HD

CRESCENT RADIO LTD.

11-15 & 17 MAYES ROAD, LONDON N22 6TL
(also) 13 SOUTH MALL, EDMONTON, N.9

MAIL ORDER DEPT.
11 MAYES ROAD, LONDON N22 6TL
Phone 888 3206 & (EDM). 803 1685

PLASTIC BOXES



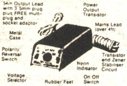
THE FOLLOWING
SIZES ARE AVAILABLE

a b c
1005 — 10·5 cm × 7·3 cm × 4·7 cm = **51p**
1006 — 14·9 cm × 7·3 cm × 4·8 cm = **66p**
1007 — 18·2 cm × 12·2 cm × 6·4 cm = **96p**
:- 1021 — 10·6 cm × 7·4 cm × 4·5 cm = **50p**
Post and Packing 10p
:- SLOPING FRONT 60DEG (Approx.)

stabilised

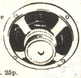
POWER PACK/CONVERTER

Switched 3. 6. 7½ or 9 volts.
Up to 400mA Output



£5·25 + **VAT.** 16p P. & P.

ELAC HI-FI



10" Twin Cone Speaker.

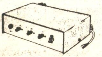
7 Watts

Free Air

40 Hz 12000 Hz

£3·75 P. & P. 25p.

3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT



Three Channel: Bass—Middle—Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed.)

£18·50 plus 38p P. & P.

"CRESCENT" 100 WATT R.M.S. ALL PURPOSE AMPLIFIER U . BUILD . IT

We supply the three modules for you to build this Disco-Group-P.A. amplifier into the cabinet of your choice.

★ THE POWER AMP MODULE

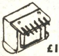
170W. r.m.s. sq. wave 300W instantaneous peak into 8 ohm (60W into 16 ohm). **£14·28,** carr. 45p.

★ THE PRE-AMP MODULE

Four control pre-amp, Vol. Bass, Treble. Middle controls. Designed to drive most amplifiers using F.E.T. first stage. **£3·96** carr. 25p.

★ THE POWER SUPPLY

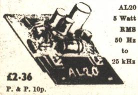
Is supplied complete with the mains transformer. **£9·66,** carr. 50p. Complete fixing instructions are supplied and no technical knowledge is required to connect the three ready wired modules. A fantastic bargain. If you purchase all three modules. **£25,** carr. 75p. Send S.A.E. for further details on this or our ready built amplifiers.



MAINS TRANSFORMER

200–240 PR1
180v. 50MA SEC.
6·3v. 1 Amp Sec.

£1·00 + 10p P. & P. EACH



AL20
5 Watt
RMS
50 Hz
to
25 kHz

£2·36
P. & P. 10p.

CRESCENT CATALOGUE

If you construct you should own one. Send **20p** inc. carriage.

★

VAT

Please include 10% VAT on goods plus carriage.

EXPRESS COMPONENTS

17, Albert Square, London, E15 1HJ

fuzz box

INTRODUCING the first of our electronic kits for the musician, suitable for use with electric guitars and organs. Kit comes complete with wire, solder, ready drilled case and step-by-step instructions. (Batteries are not supplied).

PRICE FOR KIT OF PARTS £5.75 inc. p. & p.

Resistors
10Ω—2.7MΩ **1p** each
E12 ¼W 5% low noise

Capacitors μF/V	
2/25	**6p**
10/10	**6p**
10/25	**7p**
33/25	**7p**
100/10	**7p**
100/40	**7p**
500/25	**15p**
1000/25	**20p**
1000/40	**25p**
2000/12	**20p**
2000/50	**35p**
2200/25	**30p**

Diodes	
OA81	**8p**
OA91	**8p**
1N4148	**5p**

Potentiometers
1k lin.
10k lin.
10k log.
22k log.
50k lin.
100k lin.
470k log.
1M lin.
} **15p**
All carbon track

Transistors	
AD142	**35p**
AD161/162 mp	**65p**
BC107/8/9	**10p**
BC184	**11p**
OC71	**12p**
OC75	**18p**
OC204	**25p**
OCP71	**55p**
2N2926G	**12p**
2N3704	**12p**

Meters	
MR38P 100μA	**£2 25p**

I.C's	
748 8-pin d.i.l.	**40p**
7400 14-pin d.i.l.	**18p**
NE550L TO-5	**95p**
NE555V 8 pin d.i.l.	**90p**

Transformers	
Mains/6V ½A	**80p**
Beta M218	**£1 85p**

Miscellaneous	
Crystal earpiece and socket	**70p**
8, 14-pin d.i.l. sockets	**18p**

C.W.O. only add 15p p & p S.A.E enquiries

---

become a RADIO-AMATEUR !

learn how to become a radio-amateur in contact with the whole world. We give skilled preparation for the G.P.O. licence

RAPY

free! Brochure, without obligation to:

BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL P.O. Box 156, JERSEY

NAME : ______________________

ADDRESS : ______________________

EEB 8.4.
______________________ **BLOCK CAPS please**

RECORD PLAYBACK HEADS (TRUVOX)

Individual prices of these are:
2 track record playback heads **50p** each.
4 track record playback heads **72p** each.
Erase heads are also available separately:
2 track **33p**; 4 track **55p**.

NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts. **8p** each, 10 for **60p**. Plastic pushrod suitable for operating. **6p** each, 10 for **54p**.

1 R.P.M. MOTOR+GEAR-BOX

Made by the famous Chamberlain & Hookham Ltd. These could be made to drive clock or similar. Really robust reliable unit.
Price **£1·10** each.

AUTO—ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. **£6·35** plus 25p post and insurance.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **£1·10**, plus 20p postage.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **25p** each.

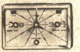
MULTI-SPEED MOTOR

Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000, 12,000 & 15,500 r.p.m. Shaft is ½ in. diameter and approximately 1 in. long. 230/240v. Its speed may be further controlled with the use of our Thryrister controller. Very powerful and useful motor size approx. 2 in. dia. × 5 in. long. Price **97p** plus 23p postage and insuranec.

SLIDE SWITCHES

Slide Switch. 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in × ⅜in rated 250V lamp. **8p** each. 10 for **73p**. Ditto as above but for printed circuit **6p** each, 10 for **53p**

Sub Miniature Slide Switch. DPDT 19mm (¾in approx.) between fixing centres. **20p** each or 10 for **£1·90**. SP Change over spring return 250v 1 amp. **11p**.



15A ELECTRICAL PROGRAMMER

Learn in your sleep: Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an electrical programmer Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price **£2·15** + 20p p & p or with glass front chrome bezel **83p** extra.

BALANCED ARMATURE UNIT

500 ohm, operates as speaker or microphone, so useful in intercom or similar circuits, **37p** each.

12 VOLT 1½ AMP POWER PACK

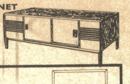
This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 m/f/d/ smoothing. Price **£2·20** + p. & p. 20p.

Heavy Duty Mains Power Pack. Output voltage adjustable from 15–40V in steps—maximum load 250W—that is from 6 amp at 40V to 15amp at 15V. This really is a high power heavy duty unit with dozens of workshop uses. Output voltage adjustment is very quick—simply interchange push on leads. Silicon rectifiers and smoothing by 3,000mF. Price **£6·33** plus 65p post

RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only **£1·10** each or £12 per dozen, specify 5, 10 or 15 amp—*simply fit in place of switch.*

STEREO RADIOGRAM CABINET



Long, Low and Modern. Teak veneered with sliding front and tapered legs. Speaker spaces each end. Size approx. 4ft. 2in. × 15in. × 15in. Probably cost over £20 to make. Our Price **£8·10** each.

THIS MONTH'S SNIP
ULTRA MODERN RECORD CHANGER.
Famous BSR deck with stereo cartridge. £6·95 + £1·00 post.

HORSTMANN 24-HOUR TIME SWITCH

With 6 position programmer. When fitted to hot water systems this could programme as follows :—

Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact there is no limit to the versatility of this Programmer. Mains operated. Size 3in. × 3in. × 2in. deep. Price **£3·85** as illustrated but less case.

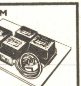
PORTABLE RADIO CASE DE·LUXE

A similar size to the above but a more expensive design. Used with the Good Companion de-luxe model. **£2·20** plus 50p post and insurance.

KETTLE ELEMENTS

Made by the famous A.E.I. Co. Complete with washers and combined fixing ring and plug shroud. Normal 2 round pin and flat pin earth connection and overload reset push button. 2 Models—1¼in (approx.) suitable for Swan and other similar models—1⅞in (approx.) suitable for G.E.C., Hotpoint, etc. All quick boil 2¼kW elements at 240V. Price **£1·38.**

MULLARD UNILEX STEREO SYSTEM



There is no doubt that it is a good system, we believe that for the money it is without comparison. We demonstrate gladly at our Tamworth Road depot. Prices of the individual items for this:—

1 Unilex Amplifier	Ref. EP.9000	**£1·60**
1 Unilex Amplifier	Ref. EP.9000	**£1·60**
1 Unilex Pre-Amp	Ref. EP.9001	**£1·80**
1 Unilex Power Unit	Ref. EP.9002	**£2·30**

1 Control panel kit with spun aluminium faced knobs **£3·30** Or the complete outfit—**£11·30** post + VAT paid. Pair of 15 ohm speakers made by E.M.I. are also available if required, **£3·30** the pair. No extra postage if ordered with the above, otherwise add 25p

SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc. 24in × 18in **£1·69**. 13in × 10in **£1·21**.

HORSTMANN "TIME & SET" SWITCH

(A30 Amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc. up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Two models 15 amp **£1·98**, 30 amp **£2·58** p & p 25p each.

SMOKE WILL KILL—GAS WILL KILL—FIRE WILL KILL

But, if you install SAGA (our smoke and gas alarm) your family will have the latest electronic protection, against these killers. Saga uses a fantastic electronic sensor which "smells" smoke and gas and sounds the alarm immediately, in a neat case measuring approx. 5in × 3½in × 2¼in, it has its own internal alarm, also a connector for additional bells. You just plug it in to the mains and hang it near the ceiling. Saga uses so little electricity that it will hardly move the meter, leave it on always to give night and day protection. One year's guarantee, also 7-day cash return offer, **£6·99** plus 30p post and service.

OUR 1974 CATALOGUE LISTING HUNDREDS OF BARGAINS
NOW AVAILABLE
PRICE 30p POST PAID

CENTRIFUGAL BLOWER

Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quiet running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4½″ × 4½″ × 4″. When mounted by flange, air is blown into the equipment but to suck air out, mount it from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering etc. etc. A real bargain at **£2·05**

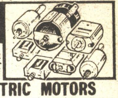
RADIO STETHOSCOPE

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **£2·20**, twin stethoset instead of earpiece **88p** extra—post and ins. 20p.

UNILEX MULLARD 4 WATT HI-FI AMPLIFIER FOR ONLY £1·60

Sensational "once in a lifetime offer" because Mullard over-produced—definitely not repeatable once our stocks (now over half sold) are cleared. Hi-Fi 4 transistor amplifier complete in case ready to use, batt., car or mains operated—freq. range 50hz–15Khz—distortion better than ·2%. Comes complete with guarantee and data FREE to purchasers. Great handbook published by Mullard "tells all you need to know" to build your own stereo. Complete Unilex Stereo System **£11·30**, pair of speakers for same **£3·80**.

ONLY £1 FOR 7 ELECTRIC MOTORS



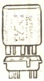
7 powerful battery motors as used in racing cars and power models. Output and types vary to make them suitable for hundreds of different projects—tools, toys, models, etc. All brand new, reversible and for 1½ to 12v. Bats., wiring diagrams included. Post and VAT 30p.

FREE Details of how to make miniature power station.

FERRITE RODS

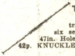
For aerials, etc. The following types are in stock: Dia. ⅜″, 4″ long **15p**, 5″ long **18p**. Dia. ⁵⁄₁₆″, 5″ long **20p**, 6″ long **25p**, 8″ long **30p**. Dia. ⅜″, 4″ long **20p**, 5″ long **25p**, 6″ long **30p**. 8″ long **40p**. Dia. ½″, 6″ long **35p**; Ferrite Slab 3″ long × ¾″ × ⅛″ **20p**.

MINIATURE SEALED RELAY



American made. Our Ref. No. REL A1. Measures only ¾″ wide × ½″ thick and ¾″ high and it's a double change over, we don't know the contact rating but estimate this at 3/5 amps. The coil resistance is 600 ohms and 9–12 volt will close it. Ideal for models and miniaturised equipment. It's a plug in relay but we supply complete with base. Price **38p** including base.

TELESCOPIC AERIAL



for portable, car radio or transmitter. Chrome plated—six sections, extends from 7½ to 47in. Hole in bottom for 6BA screw. **42p**. KNUCKLED MODEL FOR F.M. **55p**

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless, August issue. **£3·30** plus 20p post and insurance

MIDGET TWO GANGS

Tuning condenser as fitted to many Japanese and Hong Kong radios—probably 200pf each section with ¼″ spindle with terminal—less trimmers. Price **38p**. With trimmers **50p**.

NUMICATOR TUBES

For digital instruments, counters, timers clocks, etc. Hi-vac XN.3. Price **99p** each. 10 for **£9**.

MAINS OPERATED SOLENOIDS

Model TT2—small but powerful 1″ pull—approx. size 1½″ x 1½″ x 1½″. **66p**. **Model 400/1** ⅞″ pull. Size 2⅛″ x 2″ x 1⅞″. **83p**. **Model TT10** 1¼″ pull. Size 3″ x 2½″ x 2½″. **£1·98** plus 20p post and insurance.

TERMS:—
Add 10% V.A.T.
Send postage where quoted—other items, post free if order for these items is £6.00, otherwise add 30p.

J. BULL (ELECTRICAL) LTD.

(Dept. E.E.), 102/3 TAMWORTH RD.,
CROYDON CRO IXX.

R T V C FOR AUDIO ON A BUDGET

PUSH BUTTON CAR RADIO KIT

The Tourist II

NO SOLDERING REQUIRED!

NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly.
Fine tuning push button mechanism is fully built and tested to mate with printed circuit board.
Technical specification:

(1) **Output** 4 watts R.M.S. output. For 12 volt operation on negative or positive earth.
(2) **Integrated circuit** output stage, pre-built three stage IF Module.

Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands.
Size chassis 7″ wide, 2″ high and $4\frac{5}{16}$″ deep approx

Car Radio Kit £7.70 + 55p post. & pack.
Speaker including baffle and fixing strip
£1.65 + 23p postage & packing
Car Aerial Recommended – fully retractable and locking
£1.35 post paid

STEREO 21

QUALITY SOUND(*) FOR LESS THAN £19·00

Stereo 21 easy to assemble audio system kit, – no soldering required. Includes:—
BSR 3 speed deck, automatic, manual facilities together with ceramic cartridge.
Two speakers with cabinets.
Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

For the technically minded:—

Specifications:
Input sensitivity 600mV: Aux. input sensitivity 120mV: Power output 2.7 watts per channel: Output impedance 8–15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs – radio, tape, etc., and outputs for taping discs. **Overall Dimensions.** Speakers approx. $15\frac{1}{2}$″ × 8″ × 4″. Complete deck and cover in closed position approx. $15\frac{1}{2}$″ × 12″ × 6″. Complete only **£18.95** **+£1.60 p & p.**

Extras if required.
Optional Diamond Styli **£1.37**
Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance, **£3.85.**

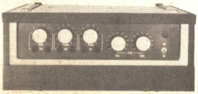
DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.
Outputs 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).
Inputs *4 Electrically Mixed Inputs *3 Individual Mixing controls. *Separate bass and treble controls common to all 4 inputs *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling.

INPUT SENSITIVITIES
–Input–1.) Crystal mic. guitar or moving coil mic, 2, and 10 mV. (selector switch for desired sensitivity.–Inputs–2), 3), 4, Medium output equipment–ceramic cartridge, tuner, tape recorder, organs etc.
– all 250mV sensitivity.
AC Mains 240V. operation.
Size approx. $12\frac{1}{2}$ ins × 6 ins × $3\frac{1}{2}$ ins

£15.00 + 60p. post & pack

DISCO 50



45 WATT R.M.S. MONO DISCOTHEQUE AMPLIFIER

Ideal for Disco Work. Output Power: 45 watts R.M.S. Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K. Size: $19\frac{1}{4} \times 10\frac{1}{2} \times 8$ins. approx. Amplifier **£27.50+£1.50 p. & p.**

Special Offer: Disco 50 plus two 15″ E.M.I. speakers type 14A/780 (as illustrated on opposite page). **Complete £57.00+£4.00 p&p.**

COMPLETE(*) STEREO SYSTEM

£51·00

40 Watt Amplifier.
Viscount III – R102 now 20 watts per channel.
System I includes,

Viscount III amplifier – volume, bass, treble and balance controls, plus switches for mono/stereo on/off function and bass and treble filters. Plus headphone socket.

Specification
20 watts per channel into 8 ohms.
Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ±1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to –17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to –12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.) –58dB.
Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13¾″ × 9″ × 3¾″

Garrard SP25 deck, with magnetic cartridge, de luxe plinth and hinged cover.

Two Duo Type II matched speakers – Enclosure size approx. 17½″ × 10¾″ × 6″ in simulated teak. Drive unit 13″ × 8″ with parasitic tweeter. 10 watts handling

Complete System £51.00

£69·00

System II
Viscount III amplifier (As System I)
Garrard SP. 25 (As System I)
Two Duo Type IIIA matched speakers— Enclosure size approx. 31″ × 13″ × 11½″. Finished in teak veneer. Drive units approx. 13½″ × 8¼″ with 3¼″ HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.

Complete System £69.00

PRICES: SYSTEM 1

Viscount III R 102 amplifier	£24·20 + £1 p & p
2 Duo Type II speakers	£14·00 + £2·20 p & p
Garrard SP25 with MAG. cartridge de luxe plinth and hinged cover	£21.00 + £1.75 p & p.
total	£59.20

Available complete for only £51.00 + £3·50 p. & p.

PRICES: SYSTEM 2

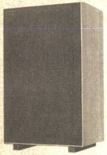
Viscount R102 amplifier	£24·20 + £1·00 p. & p.
2 Duo Type IIIA speakers	£39·00 + £4·00 p. & p.
Garrard SP25 with MAG cartridge de luxe plinth and hinged cover	£21·00 + £1·75 p. & p.
total	£84·20

Available complete for only £69.00 + £4 p & p.

EMI SPEAKERS AT FANTASTIC REDUCTIONS

THE ULTIMATE COMPLETE SPEAKER SYSTEM

EMI LE 315 **List Price £86.00**



A professional standard five way speaker system with enclosure giving top quality performance.

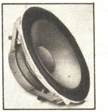
Enclosure Dimensions
approx. (3ft. × 2ft. × 1ft.).

Drive Units
Hand built – 15″ diameter bass with 3″ voice coil, – two 5″ diameter Mid Range units, – two 3¼″ HF. units, plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment.

Power Handling
Continuous rating 35 W rms., Peak power rating 70 W.

Frequency Response
20 Hz 20,000 Hz. Imp. 8 ohms.

Our price £45·00 + £3·50 p. & p.



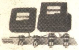
15″ 14A/780 BASS UNIT

Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3″ voice coil.

Recommended retail price £40·80.
OUR PRICE £18·70 + £1·50 p & p

950 KIT

Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19″ × 14″ (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.
The four 10,000 gauss tweeters, each 3¼″ dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2″, others 0·5″. Recommended list price £44·00. **OUR PRICE £19.50 + £1·50 p & p Special Offer.**



BUILD YOUR OWN STEREO AMPLIFIER(*)

For the man who wants to design his own stereo — here's your chance to start, with Unisound — pre-amp, power amplifier and control panel. No soldering — just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only.

£7·64 + 55p. p & p

8 TRACK CARTRIDGE PLAYER(*)

Elegant self selector push button player for use with your stereo system. Compatible with Viscount III system, Unisound module and the Stereo 21.
Technical specification Mains input, 240V, Output sensitivity 125mV
Comparable unit sold elsewhere at £24·00 approx.

Yours for only £10.95 + 90p. p & p

BARCLAYCARD

Just write your order giving your credit card number
DO NOT SEND YOUR CARD

- **Mail orders to Acton. Terms C.W.O. All enquires Stamped Addressed Envelope. Goods not despatched outside U.K.**
- **Leaflets available for all items listed thus (*) Send stamped addressed envelope.**

R T V C
Radio and TV Components (Acton) Ltd.

21 High Street, Acton, London W3 6NG /c
323 Edgware Road, London W2

Personal Shoppers — Edgware Road: 9a.m.–5.30p.m. Half day Thurs.
Acton: 9.30 a.m.-5 p.m. Closed all day Wed.

YATES ELECTRONICS
(FLITWICK) LTD

DEPT. E.E., ELSTOW STORAGE DEPT.
KEMPSTON HARDWICK,
BEDFORD.

C.W.O. PLEASE. POST AND PACKING PLEASE ADD 10p TO ORDERS UNDER £2.

Catalogue which contains data sheets for most of the components listed will be sent free on request. 10p stamp appreciated.

PLEASE ADD 10% VAT

RESISTORS

½W Iskra high stability carbon film—very low noise—capless construction.
½W Mullard CR25 carbon film—very small body size 7·5 x 2·5 mm.
½W 2% ELECTROSIL TRS.

Power watts	Tolerance	Range	Values available	Price 1–99	Price 100+
½	5%	4·7Ω–2·2mΩ	E24	**1·3p**	**1·1p**
½	10%	3·3MΩ–10MΩ	E12	**1·3p**	**1·1p**
½	2%	10Ω–1MΩ	E24	**3·5p**	**3p**
⅛	10%	1Ω–3·9Ω	E12	**1·3p**	**1·1p**
⅛	5%	4·7Ω–1MΩ	E12	**1·3p**	**1·1p**
4	10%	1Ω–10Ω	E12	**8p**	**7p**

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK

0·5 watt 5% Iskra resistors 5 off each value 4·7Ω to 1MΩ.
E12 pack 325 resistors **£2·40**. E24 pack 650 resistors **£4·70**.

POTENTIOMETERS

Carbon track 5kΩ to 2MΩ, log or linear (log ¼W, 1in ½W).
Single, **14p**. Dual gang (stereo), **49p**. Single D.P. switch **28p**.

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0·1 matrix).
Sub-miniature 0·1W, **5p** each. Miniature 0·25W, **7p** each.

SMOKE AND COMBUSTIBLE GAS DETECTOR—GD1

The GDI is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector. Detector GD1 **£2**. Kit of parts for mains operated detector, including GD1 but excluding case **£5·60**. Suitable case **£1·50**. Kit of parts for 12 or 24V battery operation, including GD1 and PC Board **£7·70**. As above for PP9 battery **£6·90**. Note: the battery operated kits incorporate our patented circuit to minimise battery drain—typically 90mA for 24V.

PRINTED BOARD MARKER

97p

Draw the planned circuit onto a copper laminate board with the P.C. Pen allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief.

MULLARD POLYESTER CAPACITORS C296 SERIES

160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF, **3½p.** 0·15μF, **4½p** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p.** 1·0μF, **13p.**

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, **3p.** 0·033μF, 0·047μF, 0·068μF, **3½p.** 0·1μF **4p.** 0·15μF, 0·22μF, **5p.** 0·33μF, **6½p.** 0·47μF , **8½p.** 0·68μF, **11p.** 1·0μF **13p.** 1·5μF, **20p.** 2·2μF, **24p.**

MYLAR FILM CAPACITORS

100V: 0·001μF, 0·002μF, 0·005μF, 0·01μF, 0·02μF, **3p.** 0·04μF, 0·05μF, 0·023μF, 0·1μF, **4p.**

CERAMIC DISC CAPACITORS

100μF to 10,000μF, **2p** each.

ELECTROLYTIC CAPACITORS

(μFv) 1·63, 1·5/63, 2·2/63, 3·3/63, 4·7/63, 6·8/40, 6·8/63, 10/25, 10/63, 15/16, 15/40, 15/63, 22/10, 22/25, 22/63, 33·6·3, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6·3, 68/16, 100/4, 100/10, 100/25, 150/6·3, 150/16, 220/4, 220/6·3, 220/16, 330/4, **6p.** 47/63, 100/40, 150/25, 220/25, 330/10, 470/6·3 **7p.** 68/63, 150/40, 220/40, 330/16, 1000/4, **10p.** 470/10, 680/6·3, **11p.** 100/63, 150/63, 220/63, 1000/10, **12p.** 470/25, 680/16, 1500/6·3, **13p.** 470/40, 680/25, 1000/16, 1500/10, 2200/6·3, **18p.** 330/63, 680/40, 1000/25, 1500/16, 2200/10, 3300/6·3, 4700/44, **21p.**

SOLID TANTALUM BEAD CAPACITORS

12p

0·1μF	35V	2·2F	35V	22μF	16V
0·22μF	35V	4·7F	35V	33μF	10V
0 47μF	35V	6·8F	25V	47μF	6·3V
1·0μF	35V	10F	25V	100μF	3V

VEROBOARD

	0·1	0·15
2½ x 3¾	**24p**	**20p**
2½ x 5	**28p**	**28p**
3¾ x 3¾	**28p**	**28p**
3¾ x 5	**32p**	**32p**
17 x 2½	**85p**	**67p**
17 x 3¾	**120p**	**108p**
17 x 3¾ (plain)	**76p**	**52p**
17 x 2½ (plain)	—	**41p**
2½ x 5 (plain)	—	**12p**
2½ x 3¾ (plain)	—	**11p**
Pin insertion tool	**62p**	**62p**
Spot face cutter	**52p**	**52p**
Pkt. 50 pins	**20p**	**20p**

JACK PLUGS AND SOCKETS

Standard screened	**28p**	2·5mm insulated	**12p**
Standard insulated	**18p**	3·5mm insulated	**12p**
Stereo screened	**40p**	3·5mm screened	**18p**
Standard socket	**20p**	2·5mm socket	**11p**
Stereo socket	**30p**	3·5mm socket	**11p**

D.I.N. PLUGS AND SOCKETS

2 pin, 3 pin, 5 pin 1800, 5 pin 2400, 6 pin, 7 pin
Plug 12p. Socket 8p.
4 way screened cable, **25p**/metre.
6 way screened cable, **30p**/metre.

BATTERY ELIMINATOR

£1·70

9V mains power supply. Same size as PP9 battery.

ENGINEERS FREE YOURSELF FOR A BETTER JOB WITH MORE PAY!

Do you want promotion, a better job, higher pay? "New Opportunities" shows you how to get them through a low-cost B.I.E.T. home study course. There are no books to buy and you can pay-as-you-learn.

The B.I.E.T. guide to success should be read by every ambitious engineer. Send for this helpful 76 page FREE book now. No obligation and nobody will call on you. It could be the best thing you ever did.

CUT OUT THIS COUPON

POST NOW

CHOOSE A BRAND NEW FUTURE HERE!

Tick or state subject of interest. Post to the address below.

- Practical Radio & Electronics (Technatron) ☐
- Electronic Engineering ☐
- Television Maintenance & Servicing ☐
- General Radio & TV Engineering ☐
- Radio Servicing, Maintenance and Repairs ☐
- City & Guilds Radio, TV Electronics Mechanics ☐
- Radio Amateurs ☐
- Practical TV ☐
- Colour Television ☐
- Computer Electronics ☐
- C & G LI Radio TV Servicing Cert. ☐
- Post Master General 1st & 2nd class Certs. ☐
- C & G Electrical Engineering Practise ☐
- C & G LI Installations and Wiring ☐
- General Electrical Engineering ☐
- Society of Engineers (Electrical Eng.) ☐
- Electrical Installations and Wiring ☐
- C & G Electrical Technicians (Primary) ☐
- C & G Telecommunications ☐

To B.I.E.T. **BEE** 06 Aldermaston Court, Reading RG7 4PF QK **BEE 06**

NAME (Block Capitals Please) ....

ADDRESS ....

....

Other subjects .... Age ....

Accredited by C.A.C.C. *Member of A.B.C.C.*

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

SOLDERING GUN

ELECTRIC TRANSFORMER TYPE
INSTANT HEAT with TRIGGER SWITCH

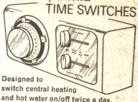
£2·75

V.A.T. PAID
P&P 33p

240 VOLTS A/C

New surplus stock as illustrated. AC240 volts. Input power 100 VA. Instant heat at touch of trigger switch in handle. Constructed in robust plastic casing with work light in front and 4′ x 3 core cable.

PROGRAMME TIME SWITCHES



New surplus stock as illustrated. Size 7″x 4″ x 3″

Smiths Time Switch with 24 hour dial which is simple to set to switch on/off twice per day at any times required. Also fitted with two lever switches which can be set to operate two circuits which can each be set to operate on Time Switch twice per day, all day, continouus, or off. Mounted in robust white plastic casing Drilled for fixing on back supplied with wiring instructions. Ideal for shop lighting and many other applications.

Designed to switch central heating and hot water on/off twice a day. Suitable for any electrical appliance up to 3 amps 240 volts A.C.

£5·50 P&P 28p

VAT paid.

SAE FOR CATALOGUE WITH MANY OTHER BARGAINS TO

C. W. WHEELHOUSE & SON,
9/13 BELL ROAD,
HOUNSLOW.
PHONE 01-570-3501.

BI-PRE-PAK

SUPPLIERS OF SEMI-CONDUCTORS TO THE WORLD

Telephone Corner

COMPLETE TELEPHONES

Normal Household Type

EX. G.P.O. **Only £1·05p** P & P 45p each

TELEPHONE DIALS

Standard Post Office type. Guaranteed in working order.

Only 27½p POST & PACKING 16½p

Tested and Guaranteed Paks

B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	55p
B81	10	Reed Switches, 1" long, ⅛" dia. High Speed P.O. type	55p
H35	100	Mixed Diodes, Germ, Gold bonded, etc. Marked and Unmarked.	55p
H38	30	Short lead Transistors, NPN Silicon Planar types	55p
H39	6	Integrated Circuits. 4 Gates BMC 962, 2 Flip Flops BMC 945	55p
H41	2	Sil Power transistors comp pair BD131/132	55p
H63	4	2N3055 type NPN Sil. power transistors. Below spec. devices	55p
H64	4	3819 N Channel FETs 2N3819 in plastic case	55p

Unmarked Untested Paks

B1	50	Germanium Transistors PNP, AF and RF	55p
B66	150	Germanium Diodes Min. glass type	55p
B83	200	Transistors, manufacturers rejects, AF, RF, Sil. and Germs.	55p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	55p
B86	100	Sil. Diodes sub. min. IN914 and IN916 types	55p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	55p
H67	10	3819N Channel FETs plastic case type	55p

Make a rev counter

for your car

The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system. **£1·10p each**

Ex GPO Push Button Intercom Telephones

Exactly as internal telephone systems still in everyday use where automatic internal exchanges have not yet taken over. Available in 5, 10 or 15 ways. Complete with circuits and instructions. Price of each instrument is independant of the number of ways. Please phone for latest details of cable.

£2.75 p.p. 38½p Per Instrument

Extension Telephones. 71½p each. p.p 27½p. **£1·37½** for 2. P.&P. 55p.
These phones are extensions and do not contain bells.

New X Hatch

Our new vastly improved Mark Two Cross Hatch Generator is now available

Essential for alignment of colour guns on all colour T.V. receivers. Featuring plug in IC's and a more sensitive sync. pick-up circuit. The case is virtually unbreakable—ideal for the engineer's tool box—and only measures 3" x 5¼" x 3".

Ready built unit only **£10·92** Complete kit **£8·72**

(includes V.A.T. and p. & p. but no batteries)

LM380

AUDIO IC

We have just received a large consignment of LM380 IC's. These are specially selected to a higher grade and are marked with the number SL60745.

This **fantastic** little 3watt audio IC only requires two capacitors and two potentiometers to make an amplifier with volume and tone control. The quality is good and has to be heard to be believed.

Our special price £1·10ea **complete with data and projects book**

Over 1,000,000 Transistors

in stock

We hold a very large range of fully marked, tested and guaranteed transistors, power transistors, diodes and rectifiers at very competitive prices. Please send for free catalogue.

Our very popular 4p transistors

TYPE "A" PNP Silicon alloy, TO-5 can
TYPE "B" PNP Silicon, plastic encapsulation
TYPE "E" PNP Germanium AF or RF
TYPE "F" NPN Silicon plastic encapsulation
TYPE "G" NPN silicon similar ZTX 300 range
TYPE "H" PNP silicon similar ZTX 500 range

8 RELAYS FOR VARIOUS TYPES P & P 27½p **£1·10p**

UHF TV Tuner Units

Brand new by a famous manufacturer

Data supplied £2.75

Plastic Power Transistors

NOW IN TWO RANGES

These are 40W and 90W Silicon Plastic Power Transistors of the very latest design, available in NPN or PNP at the most shatteringly low prices of all time. We have been selling these successfully in quantity to all parts of the world and we are proud to offer them under our Tested and Guaranteed terms.

Range 1. VCE. Min 15. HFE Min 15.

	1–12	13–25	26–50
40 Watt	22p	20p	18p
90 Watt	26½p	24½p	22p

Range 2. VCE. Min. 40. HFE Min 40

	1–12	13–25	26–50
40 Watt	33p	31p	29p
90 Watt	38½p	36½p	33p

High Speed Magnetic Counters 4 digit (non-reset) 24V or 48V 4 × 1 × 1in **33p** p & p 5p.

INTEGRATED CIRCUITS

We stock a large range of I.Cs at very competitive prices (from **11p** each). These are all listed in our FREE Catalogue, see coupon below.

METRICATION CHARTS now available

This fantastically detailed conversion calculator carries thousands of classified references between metric and British (and U.S.A.) measurements of length, area, volume, liquid measure, weights etc.

Pocket Size **15p** Wall Chart **18p**

LOW COST DUEL IN LINE I.C. SOCKETS

14 pin type at **16½p** each } Now new low profile
16 pin type at **18p** each } type

BOOKS

We have a large selection of Reference and Technical Books in stock. Details are in our latest Catalogue. Send for it TODAY. using the coupon below. N.B. Books are void of V.A.T.

Send for lists of publications

Our famous P1 Pak

is still leading in value

Full of Short Lead Semiconductors & Electronic Components, approx. **170**. We guarantee at least **30** really high quality factory marked Transistors PNP & NPN, and a host of Diodes & Rectifiers mounted on Printed Circuit Panels. Identification Chart supplied to give some information on the Transistors.

11p P & P on this Pak.

Please ask for Pak P.1. only 55p

Please send me the FREE Bi-Pre-Pak Catalogue

NAME ....

ADDRESS ....

....

ALL PRICES INCLUDE 10% VAT

MINIMUM ORDER 50p. CASH WITH ORDER PLEASE. Add 11p post and packing per order OVERSEAS ADD EXTRA FOR POSTAGE

BUY THESE GOODS WITH ACCESS

BI-PRE-PAK LTD

Dept.D. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX.
TELEPHONE: SOUTHEND (0702) 46344

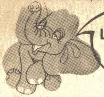
Co Reg No 820919

Henry's

DON'T RELY ON YOUR MEMORY
BUY NOW AT BARGAIN PRICES
Hi Fi and Transistors – Up to date
Brochures on request

HENRY'S CATALOGUE

Due to rapid price changes, shortages of paper and raw materials, all prices in the existing catalogues no longer apply. Call or phone for latest prices. A new catalogue will be available for Aug/Sept. 1974.



UK's LARGEST RANGE OF KITS & GADGETS

TEST EQUIPMENT

MULTIMETERS

(carr. etc. 30p)

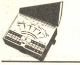
ITI-2	20K/Volt Slimline	£5·95
M210	(Case £1·25) 20K/Volt Slimline de-luxe	£6·75
TLH33D	2K/Volt Robust	£7·50
U4323	(+IF8AF Osc)	£7·00
AF105	(Case £2·25) 50K/Volt	£12·50
U4313	20K/Volt AC current. Steel case	£10·50
U4341	Plus Built in transistor tester	£10·50
Model 500	(Case £2·25), 30K/Volt	£11·75

OTHER EQUIPMENT

SE250B Pocket Signal Injector	£2·25	carr. 15p
TE15 Grid Dip meter 440kHz–280mHz	£16·50	carr. 30p
TE40 AC Millivoltmeter 1·2mHz	£19·75	carr. 35p
TE6528 Range valve voltmeter	£22·50	carr. 40p
TE20D 120kHz–500mHz RF Generator	£18·95	carr. 40p
TE22D 20Hz–200kHz Audio Generator	£19·95	carr. 40p
SE350A Deluxe Signal Tracer	£12·95	carr. 20p
SE400 Volts/ohms/R-C sub./RF field/RF gen.	£15·50	carr. 20p

New Revolutionary Supertester 680R

680R Multi-tester
£18·50



Accessories

Transistor tester	£11·00
Electronic voltmeter	£18·00
Ampclamp	£11·95
Temperature probe	£11·95
Guass meter	£11·95
Signal Injector	£5·95
Phase Sequence	£5·95
EHT Probe	£5·95
Shunts 25/50/100A	£4·50

A SELECTION OF INTERESTING ITEMS

C3025 Compact transistor tester	£6·95	p & p 15p
Q4002 Photoelectric System	£13·70	
E1310 Stereo mag. cart. preamp.	£4·80	p & p 25p
Easiphone D1201 telephone amplifier	£7·50	p & p 25p
D1203 Teleamp. with PU coil	£4·95	p & p 20p
LL1 Door Intercomm. and chime	£8·40	p & p 25p
9" Twin spring unit For	£3·30	p & p 15p
16" Twin spring unit Reverbs	£6·85	p & p 25p
US50 Ultrasonic Switch Transmitter/Receiver	£12·75	
C3041 1-250 MHz	£4·25	
C3043 5CH 1-300 MHz	£5·75	
VHF 105 Aircraft Band Convertor	£4·50	p & p 15p
B2005 4 Ch. mic. mixer	£4·20	p & p 15p
B2004 2 ch. Stereo mixer	£6·75	p & p 15p
PK3 Kit. Etch your own ptd. circuits	£1·95	p & p 20p

BUILD THIS RADIO

Portable MW/LW radio kit using Mullard RF/IF module. Features MW—bandspread for extra selectivity. Slow motion tunning. Fibre glass PVC cabinet. 600MW output. All parts £7·98 (battery 22p), carr. etc. 32p.

EXCLUSIVE: SPECIAL OFFERS

MW/LW CAR RADIO + or – Earth with speaker and fixings. £6·50 c./p. 30p.

8 TRACK CAR STEREO (– Earth) with speakers in Pds & fixgs. £12·50 c./p.40p.

Portable Battery Cassette Tape Player £7·25.

Car Lighter Plug aod adaptor for all cassette and radio 6/7½/9 volt output (state width) £1·95 each

Rotel Stereophones

RH630	£6·80
RH700	£10·25
RH430	£4·14

Wein W500 Battery/Mains Cassette Recorder £12·75

PORTABLE CASSETTE TAPE PLAYER—for car or carry around. £7·25 c./p. 20p.

HANIMAX BC808 POCKET CALCULATOR WITH % KEY. £28·95

HANIMAX BC811M MEMORY VERSION £33·75

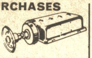
* BC807 % Key £22·95

* BCM850 % Key + Memory £33·95

*** MAINS UNIT £3·25 Extra**

HANIMAX H101 STEREO COMPACT RECORD PLAYER 2 x 7 watts. Complete with Speakers (List £54·50) Price £39·95. Plus free pair of stereo phones.

SPECIAL PURCHASES



UHF TV TUNERS CHANNELS 21 TO 64
Brand new transistorised geared tuners for 625 Line Receiver IF output. £2·50, Post 20p.

PUSHBUTTON UHF TV TUNER
New purchase of 4 button transistorised uhf tuner. £3·50 + post 20p.

EASY TO BUILD KITS BY AMTRON—EVERYTHING SUPPLIED

Model No.		
310	Radio control receiver	£3·29
300	4-channel R/C transmitter	£6·61
345	Superhet R/C receiver	£6·61
65	Simple transistor tester	£1·66
115	8 watt Amplifier	£4·50
120	12 watt amplifier	£4·73
125	Stereo control unit	£6·01
130	Mono control unit	£4·16
605	Power supply for 115	£5·31
610	Power supply for 120	£5·31
615	Power supply for 2 x 120	£6·64
230	AM/FM aerial amplifier	£3·29
240	Auto packing light	£6·90
275	Mic. preamplifier	£6·98
570S	LF generator 10Hz–1mHz	£21·45
575S	Sq. wave generator 20Hz–20Khz	£19·77
590	SWR meter	£9·47
630	STAB Power supply 6-12v 0·25-0·1A	£9·24
690	DC motor speed Gov.	£3·31
700	Electronic Chaffinch	£7·92
760	Acoustic switch	£12·57
780	Metal Detector (electronics only)	£10·91
790	Capacitive Burglar alarm	£7·92
835	Guitar preamp.	£4·99
840	Delay car alarm	£6·99
875	CAP. Discharge ignition for car engine (–Ve Earth)	£13·99
80	Scope Calibrator	£2·65
255	Level indicator	£6·98
525	120–160mHz VHF timer	£11·31
715	Photo cell switch	£8·97
795	Electronic continuity tester	£4·97
860	Photo timer	£15·51
235	Acoustic Alarm for driver	£8·61
465	Quartz XTAL checker	£9·90
220	Signal Injector	£2·30
390	VOX	£15·50
432	Testakit	£19·30
670	Buffer Battery Charger	£6·55
850	Electronic Keyer	£18·75
820	Electronic Digital Clock	£58·50

ALL KITS OFFERED SUBJECT TO STOCK AVAILABILITY

Prices correct at time of preparation. Subject to change without notice.

BUILD THIS TUNER ML3

MW/LW Radio Turner to use with any amplifier. Features Mullard RF/IF module Ferrite aerial, built in battery. Excellent results. Size 7" x 2¾" x 3⅞". All parts £5·25, carr. 15p.

Mullard FM Modules
LP1186 Tuning Heart Module.
LP1185 IF Module complete with data. Price £9·00 pair.

Sinclair Special Offer
Stereo 60 Pre-amplifier—for use with most small amplifiers. Exclusive offer £6·75.

FM Tuner Module
FM5231 12v FM Tuner £7·95.
SD4912 Stereo Decoder £7·95.
SF62H 6v Stereo FM Tuner £14·95.

PP9 Eliminator Kit
Complete module kit 9v 100mA output £1·95, p & p 25p.

TBA800 5 WATT I.C.
Suitable alternative to SL403D.
5/30 volt operated. 8/16 ohm
5 watt output.
With circuits and data £1·50.
Kit with printed circuit panel £2·70. All kits available from stock.

STROBE TUBE
ZFT4A. Suitable for December '73 Pract. Electronics £3·50.
ST2 (D32) DIAC 25p
CRS1/40 SCR 45p.
ZFT4 £3·50
ZFT8 £4·00

UK'S LARGEST RANGE OF TRANSISTORS AND DEVICES

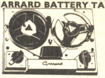
JUST A SELECTION

*TBA800 5 Watt IC	£1·50
*Sinclair IC12 6 Watt IC	£2·00
*ZN4141C Radio	£1·20
*Ultrasonic Transducers	£5·90 pr.
*3015F 7SEG Indicator	£1·70
TIL 209 LED	24p each. 22p each per 10

* With circuits/data sheet

OVER 1500 DIFFERENT SEMI - CONDUCTOR DEVICES IN STOCK
Free stock list—latest edition (Ref. 36) on request. Includes radio valves, I.C.'s Rectifiers, Triacs, SCR's, LED's, etc. More types—better prices—discounts for quantity small or large.

GARRARD BATTERY TAPE DECK



GARRARD 2 speed 9 volt tape decks. Fitted record / play and oscillator/Erase heads. Wind and rewind controls. Takes up to 4" spools. Brand new complete with head circuits. £9·50 carr. 30p.

TOP QUALITY SLIDER CONTROLS

60mm stroke high quality controls complete with knobs (post, etc. 15p any quantity).

Singles Log and Lin 5K, 10K, 22K, 50K, 100K, 250K, 500K, 1 Meg. 45p each.

Ganged Log and Lin 10K, 22K, 50K, 100K, 250K, 65p each.
Complete with knobs.

MARRIOT TAPE HEADS

4 TRACK MONO or 2 TRACK STEREO

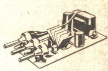
'17' High Impedance	£2·50
'18' Med. Impedance	£3·50
'36' Med. Impedance	£5·00
R730/E73 2 track mono Record/Erase low imp.	75p pair.
Erase Heads for '17', '18' and '36'	£1·00
'63' 2 track mono, Hi Imp.	£1·75
'43' Erase Head for '63'	75p

(Post, etc. 15p any qty).

SINCLAIR, MINIATURE AMPLIFIERS & TUNER/DECODER

AMPLIFIERS (carr., etc. 20p)

4-300, 0·3 watt 9 volt	£1·75
104, 1 watt 9 volt	£3·10
304, 3 watt 9 volt	£3·95
555, 3 watt 12 volt	£4·10
E1208, 5 watt 12 volt	£5·10
608, 10 watt 24 volt	£4·95
410, 10 watt 28 volt	£4·95
E1206, 30 watt 45 volt	£9·95
E1210, 2½ + 2½ watts 12 volt	£8·25
RE500, 5 watt IC mains operated Amplifier with controls	£6·30
SAC14, 7+ 7 watt Stereo with controls	£11·75
SAC13, 15 + 15 watt Stereo with controls	£14·95
SP40-5 2240/stereo 08/PZ5	£25·00
SP40-6 2Z40/stereo 80/PZ6	£27·75
SP60 2Z60/stereo 80/PZ8	£30·45
Transformer PZ8	£3·95



POWER SUPPLIES FOR EVERY PURPOSE

(All cased unless stated chassis)

470C 6/7½/9 volt 300 mA (includes Multi-Adaptor for Tape Recorders, etc.)	£2·25	post 20p
Car Lighter Voltage Adaptors 300mA (State voltage 6v, 7½v, 9v)	£1·95 ea.	post 25p
SC202 3/6/7½/9 volt 400mA	£4·25	carr. 30p
HC244R Stabilised version	£5·50	carr. 30p
P500 9 volt 500mA	£3·20	post 20p
P11 24 volt 500mA (chassis)	£2·90	post 20p
P15 26/28 volt 1 amp (chassis)	£2·90	post 20p
P1080 12v 1 amp (chassis)	£4·70	post 20p
P1081 45v 0·9 amp (chassis)	£7·80	post 20p
P12 4½–12 volt 0·4–1 amp	£7·15	post 30p
SE101A 3/6/9/12 volt 1 amp (Stab.)	£12·75	post 25p
RP164 6/7½/9/12 1 amp (Stab.)	£13·45	post 30p

FIBRE OPTICS

0·01 Diam. Mono Filament £5·50 per 100 metre reel 0·13 Diam. 64 Fibres Sheathed. £1·00 per metre. SPRAYS 15mm Diam. (Mares Tail Spray £10·50)

All types offered subject to availability. Prices correct at time of press E & OE. 10% VAT TO BE ADDED TO ALL ORDERS. UK post etc. 15p per order unless stated.

Henry's RADIO LIMITED

EDGWARE ROAD, LONDON W2

404-406 Electronic Components and Equipment 01-402 8381
309 PA – Disco – Lighting High Power Sound 01-723 6963
303 Bargains Store (Callers only)
Home and Car Entertainment Centres. London and branches now open.
120 Shaftesbury Avenue, London W1 01-437 9692
144 Burnt Oak Broadway, Burnt Oak, Edgware 01-952 7402
190-194 Station Road, Harrow, Middlesex 01-663 7788/9
354-356 Edgware Road, London W2 01-402 5854/4736

All mail to
303 Edgware Road,
London W2 1BW

All stores open 9 am to 6 pm six days a week
Hi-Fi – Tape Equipment Discount Stock List Free at all stores

ELECTROVALUE

Present THIS MONTH'S SELECTION OF GUARANTEED-TO-SPECIFICATION COMPONENTS

Everything Brand New ★ Attractive Discounts ★ Free Postage (U.K.)

Build that EE Design with EV components

TRANSISTORS

and semi-conductors of many types from simple diodes to ICS photo-sensitive devices, threshold switches, etc. etc.

MINITRON DIGITAL INDICATORS

3015F Seven segment filament, compatible with standard logic modules. 0–9 and decimal point; 9mm characters in 16 lead DIL (some alphabetical symbols available) **£1·20**
Suitable BCD decoder driver 7447 **£1·15**
3015G showing + or − & 1 & dec. pt. **£1·20**

CAPACITORS

DALY ELECTROLYTIC

in cans, plastic sleeved

1000mF/25V **28p** 1000/50 **41p**
5000/100 **£2·91** 2000/50 **57p**
5000/25V **62p** 5000/50 **£1·18**
2200/100 **£1·56**

POLYESTER TYPE C.280

Radial leads for P.C.B. mounting. Working voltage 250V d.c.

0·01, 0·015, 0·022, 0·033, 0·047 ea. **3p**
0·068, 0·1, 0·15 ea. **4p**
0·22, **5p**; 0·33 **7p**; 0·47 **8p**; 0·68 **11p**; 1·0 **14p**; 1·5 **21p**; 2·2 **24p**

SILVERED MICA

Working voltage 500V d.c.

Values in pFs—2·2 to 820 in 32 stages ea. **6p**
1000, 1500 **7p**; 1800 **8p**; 2200 **10p**; 2700, 3600 **12p**; 4700, 5000 **15p**; 6800 **20p**; 8200, 10,000 **25p**

TANTALUM BEAD

0·1, 0·22, 0·47, 1·0 mF/ 35V. ea. **14p**
2·2/16V, 2·2/35V, 4·7/16V, 10/6·3V ea. **14p**
4·7/35V, 10/16V, 22/6·3V ea. **18p**
10/25V, 22/16V, 47/6·3V 100/3V ea. **20p**

POLYCARBONATE

Type B42540 Working Voltage—250V
Values in mF:
0·0047; ·0·0068; 0·0082; 0·01; 0·012; 0·015 ea. **3p**
0·018; 0·022; 0·027; 0·033; 0·039; 0·047; 0·056
0·068; 0·082; 0·1 ea. **4p**

CERAMIC PLATE

Working voltage 50V. d.c.

In 26 values from 22pf to 6800pF, each, **2p**

POTENTIOMETERS

ROTARY, CARBON TRACK. *Double wipers for good contact and long working life*

P.20 SINGLE linear 100ohms to 4·7megohms, ea. **14p**
P.20 SINGLE log. 4·7Kohms to 2·2megohms, ea. **14p**
JP.20 DUAL GANG lin. 4·7Kohms to 2·2megohms, ea. **48p**
JP.20 DUAL GANG log. 4·7Kohms to 2·2megohms, ea. **48p**
JP.20 DUAL GANG Log/antilog 10K, 22K, 47K, 1 megohm only ea. **48p**
JP.20 DUAL GANG antilog 10K only **48p**

2A DP mains switch for any of above **14p** extra.
Decades of 10, 22 and 47 only available in ranges above.
Skeleton Carbon Presets Type PR, horizontal or vertical **6p** each.

SLIDER

Linear or log. 4·7K to 1 meg. in all popular values ea. **30p**
Escutcheon plates, black, white or light grey, ea. **10p**
Control knobs, blk/wht/red/yel/grn/blue/dk. grey/lt. grey ea. **7p**

JACKS AND PLUGS

Sockets

2-circuit unswitched S1/SS **12p**
2-circuit /2 break contacts S1/BB **15p**
3-circuit unswitched (Not GPO) S3SSS **17p**
3-circuit with 3 break contacts S3/BBB **20p**
2 circuit with chrome nut and black/white/red/green or grey unswitched S5/SS **16p**
with 2 break contacts S5/BB **20p**
Miniature 3.5mm 2-circuit, (black) 2 br. cont S6/BB **9p**

Plugs

2 circuit screened top entry P1 **24p**
side entry SEP1 **36p**
Line socket mono 231 **40p**
Line socket stereo 244 **45p**
3 circuit unscreened, bl/grey/wh. P4 **46p**
2 circuit, unscreened, bl/whi/red/bl/grn/gry P2 **18p**
3 circuit screen top entry P3 **53p**
side entry SEP3 **55p**
Miniature 3·5mm 2-circuit screened P5 **13p**
Min. 3·5mm 2-circ. unscrnd. various colours P6 **10p**

EV CATALOGUE

2nd printing

(Green and yellow cover)

112 pages, thousands of items; illustrations; diagrams; much useful technical information. The 2nd printing of this catalogue has been updated as much as possible on prices. It costs only 25p post free and includes a refund voucher for 25p for spending when ordering goods list value **£5** or more.

INSULATED SCREW TERMINALS

In moulded polypropylene, with nickel plate on brass. With insulating set, washers, tag & nuts. 15A/250V in blk/brwn/red/yel/grn/bl/gry/wh.
Type TP.1, ea. **14p**
Suitable plugs Type TP4, 4mm each **7p**
Type TP2, 2mm each **4p**

ZENER DIODES

Full range E24 values: 400mW: 2·7V to 33V, **14p** each; 1W: 6·8V to 82V, **21p** each; 1·5W: 4·7V to 75V, **67p** each. 20W: 7·5V to 75V **94p** each. Clip to increase 1·5W rating to 3 watts (type 266F), **5p**.

RESISTORS

Code	*Watts*	*Ohms*	*1 to 9*	*10 to 99* (see note below)	*100 up*	
C	1/3	4·7–470K	**1·3**	**1·1**	**0·9**	nett
C	1/2	4·7–10M	**1·3**	**1·1**	**0·9**	nett
C	3/4	4·7–10M	**1·5**	**1·2**	**0·97**	nett
C	1	4·7–10M	**3·2**	**2·5**	**1·92**	nett
MO	1/2	10–1M	**4**	**3·3**	**2·3**	nett
WW	1	0·22–3·9	**11**	**10**	**8**	
WW	3	1–10K	**9**	**8**	**6**	
WW	7	1–10K	**11**	**10**	**8**	

Codes:
C = carbon film, high stability, low noise.
MO = metal oxide, Electrosil TR5, ultra low noise.
WW = wire wound, Plessey.

Values: All E12 except C $\frac{1}{3}$W, C $\frac{3}{4}$W, and MO $\frac{1}{2}$W.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24: as E12 plus 11, 13, 16, 20, 24, 30, 36 43, 51, 62, 75, 91 and their decades.

Tolerances:
5% except WW 10% ±0·05Ω under 10Ω and MO $\frac{1}{2}$W 2%.

Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order.) Prices for 100 up in units of 100 only.

VEROBOARD

Copper clad 0·1 matrix-2·5 x 3·75 ins. **32p**: 3·75 x 3·75 ins.—**35p**: 2·5 x 5 ins. **35p**: 3·75 x 5 ins.—**24p.**
Copper class 0·15 in. matrix 2·5 x 3·75 ins.—**24p**: 3·75 x 3·75 ins.—**35p**: 2·5 x 5 ins. **35p**: 3·75 x 5 ins.—**44p.**
Vero spot face cutter (any matrix) **53p.**
0·040 pins (for 0·1 matrix) per 100—**36p.**
0·052 pins (for 0·15 matrix) per 100—**36p.**

ELECTROLYTICS

Axial Lead

µF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47	—	—	—	—	—	—	11p	8p
1·0	—	—	—	—	—	11p	—	8p
2·2	—	—	—	—	11p	—	8p	9p
4·7	—	—	—	11p	—	8p	9p	8p
10	—	—	—	—	8p	9p	8p	8p
22	—	—	8p	—	9p	8p	8p	10p
47	8p	—	9p	8p	8p	8p	10p	13p
100	9p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	28p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	18p	23p	26p	37p	41p	—	—
4,700	26p	30p	39p	44p	58p	—	—	—
10,000	42p	46p	—	—	—	—	—	—

KNOBS

In a great variety of modern types, for ¼" shaft, from plastic to solid aluminium as well as pointer and numbered types.

CONNECTORS

DIN from two way to 7 way plugs and sockets, phono types mains connections, etc. etc. Page 88 in Catalogue 7

BAXANDALL SPEAKER KIT

As designed by P. J. Baxandall and described originally in "Wireless World." Simple to assemble, fantastically good results and a greater money saver. Carries 10 watts RMS, 15 ohms impedance. Size 18in x 12in x 10in. Complete kit, including pack-flat cabinet, **£14·90.**
The size and weight of this product obliges us to charge 70p part cost of carr. in U.K.
Equaliser Assembly, **£2·30.**
Loudspeaker Unit 59RM109, **£2·45.**
Cabinet Kit (to Baxandall design), **£10·45.**
Cross-over choke for additional woofer to above **£1·50.**

This is EV Service

DISCOUNTS

Available on all items except those shown with NETT PRICES. 10% on orders from £5 to £14·99. 15% on orders £15 and over.

PACKING AND POSTAGE FREE

in U.K. for pre-paid mail orders, except Baxandall. For order list value £2 and under there is an additional handling charge of 10p.

GUARANTEE OF QUALITY

All goods are sold on the understanding that they conform to manufacturers' specifications and satisfaction is guaranteed as such—no rejects, 'seconds' or sub-standard merchandise is offered for sale.

GIRO ACCOUNT—No. 38/671/4002

Prices quoted do not include V.A.T., for which 10% must be added to total nett value of order. Every effort is made to ensure correctness of information and prices at time of going to press. Prices subject to alteration without notice.

APPOINTED STOCKISTS FOR SIEMENS QUALITY PRODUCTS

ELECTROVALUE LTD

All postal communications, mail orders etc. to Head Office at Egham address, Dept. EE8. S.A.E. with enquiries requiring answers.

Dept. EE8.
28, ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB
Telephone Egham 3603 Telex 264475 Shop hours 9–5.30 daily: Sat. 9–1 p.m.

NORTHERN BRANCH: 680, Burnage Lane, Burnage, Manchester M19 1NA
Telephone (061) 432 4945 Shop hours 9–1 p.m. 2–5.30 daily: Sat 9–1 p.m.

U.S.A. CUSTOMERS are invited to contact ELECTROVALUE AMERICA, P.O. Box 27, Swarthmore PA 19081.

Sinclair Cambridge kit.
Was £27·45.
Now only £14·95!
(INC VAT)
You save £12·50!

An advanced 4-function calculator in kit form
The Cambridge kit is the world's largest-selling calculator kit.

It's not surprising – no other calculator matches the Sinclair Cambridge in functional value for money; and buying in kit form, you make a substantial saving.

Now, simplified manufacture and continuing demand mean we can reduce even the kit price by a handsome £12·50. For under £15 you get the power to handle complex calculations in a compact, reliable package – plus the interest and entertainment of building it yourself!

Truly pocket-sized
With all its calculating capability, the Cambridge still measures just 4$\frac{1}{3}$" x 2" x $\frac{11}{16}$". That means you can carry the Cambridge wherever you go without inconvenience – it fits in your pocket with barely a bulge. It runs on ordinary U16-type batteries which give weeks of normal use before replacement.

Easy to assemble
All parts are supplied – all you need provide is a soldering iron and a pair of cutters. Complete step-by-step instructions are provided, and our service department will back you throughout if you've any queries or problems.

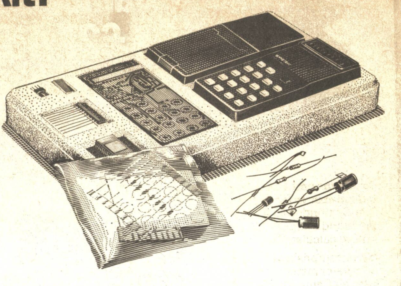
Total cost? Just £14·95!
The Sinclair Cambridge kit is supplied to you direct from the manufacturer. Ready assembled, it costs £21·95 – so you're saving £7! Of course we'll be happy to supply you with one ready-assembled if you prefer – it's still far and away the best calculator value on the market.

Features of the Sinclair Cambridge
- ✳Uniquely handy package. 4$\frac{1}{3}$" x 2" x $\frac{11}{16}$", weight 3$\frac{1}{2}$ oz.
- ✳Standard keyboard. All you need for complex calculations.
- ✳Clear-last-entry feature.
- ✳Fully-floating decimal point.
- ✳Algebraic logic.
- ✳Four operators (+, –, x, ÷), with constant on all four.
- ✳Constant acts as last entry in a calculation.
- ✳Constant and algebraic logic combine to act as a limited memory, allowing complex calculations on a calculator costing less than £15.
- ✳Calculates to 8 significant digits.
- ✳Clear, bright 8-digit display.
- ✳Operates for weeks on four U16-type batteries

A complete kit!

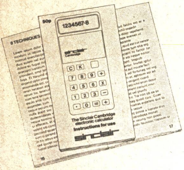
The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge. Assembly time is about 3 hours.

Contents:
1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



This valuable book – free!
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.


8 TECHNIQUES
50p
1234567·8
sinclair Cambridge
The Sinclair Cambridge electronic calculator Instructions for use
sinclair
16
17

How? It's all explained in this unique booklet, written by a leading calculator design consultant. In its fact-packed 32 pages it explains, step by step, how you can use the Sinclair Cambridge to carry out complex calculations.

Why only Sinclair can make you this offer
The reason's simple: only Sinclair – Europe's largest electronic calculator manufacturer – have the necessary combination of skills and scale.

Sinclair Radionics are the makers of the Executive – the smallest electronic calculator in the world. In spite of being one of the more expensive of the small calculators, it was a runaway best-seller. The experience gained on the Executive has enabled us to design and produce the Cambridge at this remarkably low price.

But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them – the Sinclair Project 80 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.
And *you* benefit!

Take advantage of this money-back, no-risks offer today
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch – and we guarantee a correctly-assembled calculator for one year.

Simply fill in the preferential order form below and slip it in the post today.

Price in kit form: £13·59 + £1·36 VAT. (Total: £14·95)
Price fully built: £19·95 + £2·00 VAT. (Total: £21·95)

To: Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire, PE17 4HJ

Please send me

☐ a Sinclair Cambridge Calculator kit at £13·59 + £1·36 VAT (Total: £14·95)

☐ a Sinclair Cambridge calculator ready built at £19·95 + £2·00 VAT (Total: £21·95)

*I enclose cheque for £________, made out to Sinclair Radionics Ltd, and crossed.

*Please debit my *Barclaycard/Access account. Account number________________

*Delete as required.

Name ________________

Address ________________

PLEASE PRINT

EE 8 74

sinclair

Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire
Reg. no: 699483 England
VAT Reg. no: 213 8170 88

everyday electronics

PROJECTS....
THEORY......

CURRENT PROBLEMS

Conventions are not always soundly based on logic or fact. Despite this it is sometimes preferable and convenient to continue to accept certain traditional beliefs rather than to be entirely rational.

Take, for example, the direction of electric current flow. It is generally known that time-honoured ideas conflict with scientific fact substantiated long after the idea of "positive to negative" had become firmly established. So like it or not, we have the terms conventional current (positive to negative) *and* electron current flow (negative to positive) in common usage. All very confusing. Or is it really so?

In elementary instruction electricity is often depicted as something similar to water in a system of pipes, and flowing from a high level, or pressure, downwards. Thus "positive" or high pressure always seems perfectly natural at the top of a drawn circuit diagram, with negative at the bottom.

This custom helps to preserve in our minds the idea of current flowing from positive to negative. And this convention is perfectly acceptable when considering a circuit from a purely electrical point of view.

However when looking closely into the operation of the electronic devices such as diodes and transistors (and of course thermionic valves) we cannot evade scientific truth and so have to perform some mental gymnastics, and reason everything out in an *electron flow* sense; that is, from negative to positive.

But let newcomers be quickly reassured—it sounds much more difficult and confusing than it is in practice. This two-way approach to currents becomes second nature in a short while.

A FALSE REMEDY

Not surprisingly, the apparent absurdity of the situation has brought forth from time to time demands that everyone should think exclusively in terms of electron flow. This apparently simple remedy will not do however. The custom of thinking in terms of positive to negative is too firmly engrained.

Yet far more disturbing to our mind is the rumour that some "enlightened" educationalists have not merely abandoned conventional (positive to negative) current in their teachings but have actually purloined this term and misapplied it to mean electron flow. If this is actually so, it is to be greatly deplored.

The confusion caused by such independent defiance of widely accepted conventions must build up a store of problems for the future. We have indeed already encountered some of these problems through correspondence from a few readers, all of whom have presumably been brought up in the belief that in this electronic era conventional current is as dead as the dodo.

Those who are still perplexed should find this month's *Down to Earth* helpful in unravelling this conundrum of the currents.

Fred Bennett.

Because of prevailing production problems, no firm publishing date can be announced for the September issue. Readers are advised to check regularly with their local supplier from mid-August onwards.

EDITOR F. E. Bennett ● ASSISTANT EDITOR M. Kenward ● B. W. Terrell B.Sc.
ART EDITOR J. D. Pountney ● P. A. Loates ● K. A. Woodruff
ADVERTISEMENT MANAGER D. W. B. Tilleard

© IPC Magazines Limited 1974. Copyright in all drawings, photographs, and articles published in EVERYDAY ELECTRONICS is fully protected, and reproduction or imitations in whole or part are expressly forbidden.
All reasonable precautions are taken by EVERYDAY ELECTRONICS to ensure that the advice and data given to readers are reliable. We cannot, however, guarantee it, and we cannot accept legal responsibility for it. Prices quoted are those current as we go to press.

Everyday Electronics Fleetway House, Farringdon Street, London, E.C.4. Phone: *Editorial* 01-634-4452; *Advertisements* 01-634-4202.

.EASY TO CONSTRUCT
.SIMPLY EXPLAINED

VOL. 3 NO. 8 *AUGUST 1974*

CONSTRUCTIONAL PROJECTS

LIGHTS-ON ALERT *Automatic reminder for car lights* *by E. J. Byatt* 430
HEADS OR TAILS *Simple electronic game* *by M. G. Argent* 435
EXPERIMENT IN HEADPHONE STEREO *An idea for improving headphone listening* *by W. T. Kitchen* 449
RADIATION MONITOR *Portable battery operated monitor* *by M. H. George* 454

GENERAL FEATURES

EDITORIAL 428
COUNTER INTELLIGENCE *A retailer comments* *by Paul Young* 433
SHOP TALK *Component buying for constructional projects* *by Mike Kenward* 434
JACK PLUG AND FAMILY *Cartoon* 434
TEACH-IN '74 *Lesson 11: The Field Effect Transistor* *by Phil Allcock* 438
CENTENARY OF AN AMATEUR *Marconi 'Father of Wireless'* *by Bill Maconachie* 442
KNOW YOUR COMPONENTS *Capacitors* *by Ron Adams* 448
HELP! *Common queries answered* 452
BRIGHT IDEAS *Readers' constructional hints* 453
PHYSICS IS FUN *The magnetic field* *by Derrick Daines* 458
SEMICONDUCTOR PRIMER *Facts and figures* *by A. P. Stephenson* 461
DOWN TO EARTH *Current flow* *by George Hylton* 462
READERS' LETTERS *From you to us* 465
WHAT DO YOU KNOW? *Diodes* 465

Publisher's Annual Subscription Rate, including postage to any part of the world, £2·95. International Giro facilities Account No. 5122007. State reason for payment "message to payee". Address to Everyday Electronics, Subscription Department, Carlton House, Great Queen Street, London, WC2E 9PR. Binders for volumes 1 to 3 (state which) and indexes for volume 1 and 2 available for £1.25 and 11p respectively, including postage, from Binding Department, at the above address.

We are unable to supply back copies of Everyday Electronics or reprints of articles and cannot undertake to answer readers' letters requesting designs, modifications or information on commercial equipment or subjects not published by us. An s.a.e. should be enclosed for a personal reply. Letters concerning published articles should be addressed to: The Editor, those concerning advertisements to: The Advertisement Manager, both at the address shown opposite.

NEWSAGENT

IT COULD HAPPEN TO YOU...

Place your order NOW!

LIGHTS-ON ALERT

By E. J. BYATT

Produces an audible tone when the driver inadvertently leaves on the car side lights.

It is quite common, especially during the winter months, to see car headlights unintentionally left on while the owner is at work. When he returns he finds the car difficult to start because the battery has run down and become flat.

In the light of experience this unit has been devised so that if the sidelights of the car are on when the ignition switch has been turned off, an audible warning is sounded to bring the driver's attention to this fact.

CIRCUIT

The circuit diagram of the unit is shown in Fig. 1 and can be visualised in three parts, the oscillator, amplifier and control switch.

The oscillator is the common unijunction relaxation type and comprises TR1, R1, R2 and C1.

When the battery is connected to the circuit, capacitor C1 charges up at a rate controlled by the value of R2.

While the potential at the emitter of TR1 is below a certain value the resistance between emitter and base 1 is, to all intents and purposes, infinite, but when a threshold level is reached at the emitter this resistance becomes almost zero and the capacitor discharges through this path.

FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS
including V.A.T.

£2.10
excluding case

*Based on prices prevailing at time of going to press

Once discharge has taken place the capacitor begins to charge again and the process is repeated, and continues for as long as the battery supply is connected.

Thus the voltage seen at the emitter is approximately a sawtooth waveform formed by the charge and discharge contours of the capacitor.

This sawtooth wave is coupled to the base of TR2 by C3, which blocks any d.c. content. Transistor TR2 is connected in the common emitter mode and is operated in an overdriven state. That is to say the output at the collector is a clipped sawtooth and becomes an approximate square wave.

The output of TR2 is directly coupled to the base of TR3 which amplifies the signal to feed the loudspeaker, LS1. Resistor R2 determines the output volume by controlling the current through TR3.

The oscillator frequency may be changed by altering the value of R2 slightly. Resistor R6 is selected by using the *highest* value possible without sacrificing volume and will probably lie in the range 47 ohms to 1 kilohm. In the prototype a value of 470 ohms was found satisfactory. Components R3 and C2 form decoupling between the amplifier stages and the oscillator, values are not too critical but C2 must be at *least* 100 microfarads.

If the output tone is too harsh a capacitor can be inserted between TR3 collector and base. Too large a value will reduce the output volume, try experimenting with capacitor values about 0·01 microfarads.

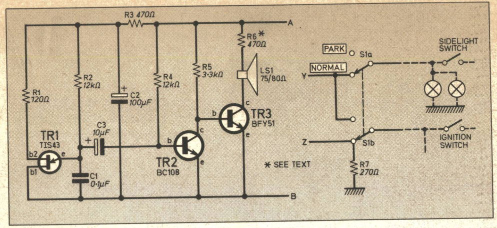


Fig. 1. Circuit diagram for the Lights-On Alert.

CONTROL SWITCH

The control switch, S1 determines the mode of operation by selecting the potentials to the supply rails of the circuit *A* and *B*.

This switch has two positions, "park" and "normal"; Table 1 gives a summary of events for the various positions of the three relevant switches.

It is seen that for S1 in the "normal" position the alarm is only sounded when the sidelights are on and the ignition switch is switched off as is the case when leaving the car parked after driving with the lights on, and forgetting to turn them off.

If it is required to park the car with the lights on, S1 should be set to "park" when the ignition is switched off.

CONSTRUCTION DETAILS

The prototype unit was constructed on a piece of 0·1in matrix Veroboard size 33 holes by 24 strips and was housed in a readily available Eddystone diecast box, size 115 x 90 x 55mm.

The layout of the components on the topside of the Veroboard is shown in Fig. 2; the layout is not critical and can be changed if desired. There are no breaks along the copper strips on the underside of the board.

Table 1: Possible switching arrangements

Ignition switch	Sidelight switch	Alarm	S1 position
On	Off	Off	Normal
On	On	Off	
Off	Off	Off	
Off	On	On	
On	Off	Off	Park
On	On	On	
Off	Off	Off	
Off	On	Off	

Begin construction by drilling the four fixing holes and then assembling the components on the board according to Fig. 2. The transistors should be soldered in place last of all and a heatshunt used to avoid thermal damage from the hot soldering iron.

Now prepare the diecast box to accept the components S1 and LS1, and the four fixing bolts. A hole drilled at one end of the box and plugged with a rubber grommet allows the three external wires to pass through.

Fix the case mounted components in position and wire up to the board as detailed in Fig. 2

Components....

Resistors

R1	120Ω
R2	12kΩ
R3	470Ω
R4	12kΩ
R5	3·3kΩ
R6	—see text
R7	270Ω 1W carbon

All ½W ±10% carbon

SEE **SHOP TALK**

Capacitors

C1	0·1µF
C2	10µF elect. 16V
C3	100µF elect. 16V

Transistors

TR1	TIS43
TR2	BC108 silicon *npn*
TR3	BFY51 silicon *npn*

Miscellaneous

S1	d.p.d.t. toggle or slide
LS1	miniature loudspeaker with coil impedance of 75–80 ohms

Veroboard: 0·1in matrix 24 strips x 33 holes; Eddystone diecast box size 115 x 90 x 55mm; 4BA nuts, bolts, washers and spacers (4 off each); rubber grommet

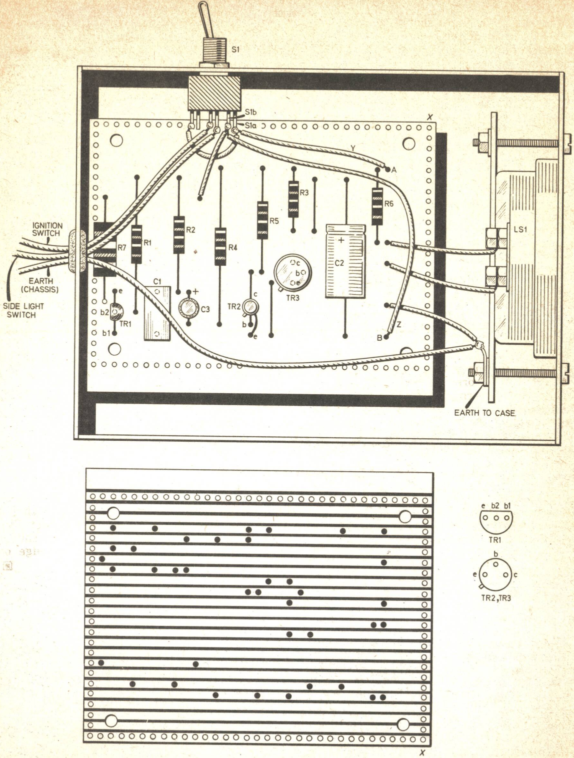


Fig. 2. Layout and wiring of the complete Lights-on Alert. Wiring is shown for negative earth, for positive earth move wire Y to point B and wire Z to point A.

according to the polarity of the car in which the unit is to be fitted.

When complete, the board should be secured in position by means of the four fixings; 10mm stand-off spacers must be used to prevent shorting of the board and case.

Thoroughly check out the wiring and when satisfied feed the three external wires (three different colours are recommended) out through the grommet and screw the lid in place. The switch positions should be labelled "park" and "normal" as shown. The unit is ready for installation in the car.

INSTALLATION AND USE

The unit should be fitted in a position within easy reach of the driver of the car. It is not necessary that the box makes contact with the car chassis as one of the flying leads provides this connection.

Connect the earth lead from the unit, to a good earth point on the car using a solder tag, nut, bolt and sprung washer.

Connect the lead from S1b pole to a tag on the ignition switch where power is supplied only when the ignition is switched on.

The lead from S1a pole should be connected to the sidelight switch on the same side as the connection to the sidelight lamps. The installation is complete.

TESTING AND USE

Set S1 in the "normal" position and switch on the sidelights. The audible tone should be heard. Switch on the ignition and the tone should cease. Switch off the ignition and the tone should be heard again and will stop when the sidelights are switched off.

Now set S1 to "park" and turn on the sidelights. No tone should be heard. Switching on the ignition will cause the alarm to sound and this then can only be muted by switching to the "normal" position.

If all the above results are observed the unit is functioning satisfactorily. Now the unit is fitted in the car, and it is not required to have the sidelights on, set S1 at "normal."

In the event of the lights being unintentionally left on once the ignition has been turned off, the alarm will sound and can only be stopped by either switching off the lights, or if parking lights are required, by putting the control switch to "park." When the driver next switches on the ignition the alarm will sound to tell him that the lights are on and the switch must be returned to "normal" before the alarm ceases.

This circuit is foolproof in that it cannot be "turned off" and will always give an indication of the lights being left on unintentionally. ▣

...Counter Intelligence

BY PAUL YOUNG

A retailer discusses component supply matters.

When there is a shortage of any commodity the person who is usually the last to be aware of it, is the ultimate consumer, in other words *you* the reader!

At least six months ago we were feeling the pinch and several months before that the manufacturers were crying out for raw materials. This was before the coal and oil problem, both of which have undoubtedly accentuated our difficulties, (many of the plastics are oil by-products).

Our old friends R. S. Components Ltd., who always made a point of keeping at least six months stock in reserve, were now running out of items much quicker. Firms whose production lines had ground to a halt, would come to us to buy three or four thousand capacitors at the full price. Only yesterday one firm wanted one hundred Bulgin knobs. We, as you all know, regard ourselves as strictly retail, and I have had to issue firm instructions to our staff, that they must not run our stocks down, to satisfy one "trade" customer, and by so doing, create one hundred disgruntled customers!

The point is, what can we, the retailer do, and you the customer do, to minimise this frustration? We certainly are trying very hard to help you. I personally have demanded to see every order where we cannot supply 100 per cent of the goods requested. I then advise the staff where I think a substitute will be acceptable.

For example, a customer will order 15μF 10V capacitor; we are out of stock, but we have in stock 15μF at 25V. Unless physical size is of paramount importance this will obviously do. You may order a $\frac{1}{4}$ watt 5 per cent resistor and we lack the particular value you require; all right, we have one in $\frac{1}{2}$ watt, so we send that.

I am sure that 99 per cent of our customers would rather receive something that is usable rather than nothing at all! For your part I would advise the following, be patient and *don't* re-order an out-of-stock item until you have checked with the firm concerned *first* (by telephone if possible). Most mail order firms are probably handling upwards a thousand orders a week. If you have had one order returned, with certain goods out of stock, don't wait a couple of weeks and re-order regardless. Because if you do, when the firm receive it, they may well feel they cannot send the order straight back to you again, and whatever they do with it, it will be easily overlooked, and the goods you want may come in and be sold again, while your order gathers the dust! Remember too, that in the circumstances that prevail to-day *no-one* can give you an accurate forecast of delivery!

It will help us tremendously if on the goods you order, you give the *widest possible* specification. For example resistors $\frac{1}{8}$ to $\frac{1}{2}$ watt, tolerance 2-20 per cent. With capacitors choose the lowest voltage you can possibly use. You will see that this gives us far more scope for finding you something.

New products and component buying for constructional projects

SHOP TALK

By Mike Kenward

OUR brief note concerning the supply of transistors for the *Transistor Assisted Ignition* last month underlines the general component supply problems that face retailers at the present time. It is not unusual to find a supplier quoting a delivery date and two or three weeks after it has passed, quoting a new date a month or two in the future.

Unfortunately, it is not always possible to blame the manufacturer as he can easily be let down on supply of raw materials such as plastic, which—as we are constantly being told—there is a world shortage of. Although some delays are unnecessary, we must ask readers to be more patient than usual and for once spare a thought for the retailer who is the "man in the middle" in this situation. We all know he is in business to make a profit but we should also realise that it is not in his interest to delay the supply of components.

Radiation Monitor

The halogen quenched gamma counter tube (CV2247)—to give the Geiger tube its correct name—for the *Radiation Monitor* is available from Henry's Radio, for £1·25 plus V.A.T. plus 20p post and packing—we make that about £1·58.

A suitable transformer for this project should be available from most of the larger suppliers—the transformer and case must be compatible. We suggest you obtain the transformer and C4 and C5 before buying the case, since these components must be able to fit into the case side by side.

Heads or Tails

The components most likely to be difficult to get hold of for the *Heads or Tails* game are, surprisingly enough, the 6V 0·06A bulbs. However, these are supplied by R. S. Components, and can be ordered by any supplier from them.

The integrated circuit is generally available for around 20p and should not cause any problems. It is a good idea to order a holder for the i.c. when purchasing it.

Lights-On Alert

Almost all the components for the *Lights-On Alert* are readily available, only the 75 ohm loudspeaker may cause problems, and Henry's Radio can supply this for 60p plus V.A.T., plus 15p post and packing—81p!

The diecast box used for housing the prototype is eminently suitable for use in cars as it is very robust and quite easily machined. Most of the larger component suppliers provide these boxes.

Experiment in Headphone Stereo

In the final design described in the *Experiment In Headphone Stereo* article on 8μF non polarised capacitor is called for—the author utilised a paper type but since these are hard to find we have suggested the use of four $2 \cdot 2\mu$F Mullard C280 types, wired in parallel—this gives $8 \cdot 8\mu$F but is near enough to the required value.

The high voltage resistors and the low value potentiometers may prove difficult to get, but these should be available from the larger suppliers—it does seem that we use that term quite often, but we cannot quote a single supplier when we know that a number of suppliers can provide particular components. Although these particular components may not be readily available, when we know of more than two or three suppliers it is not fair to quote the name of only one, and not possible to quote them all with prices etc., so **you** must do some hunting.

The headphones mentioned in the text have not been recommended by us, they are quite simply those that the author purchased—any 8 ohm to 16 ohm stereo types will do.

JACK PLUG & FAMILY...
TELL ME SOMETHING — IF YOU'RE TESTING YOUR SOUND-IMPROVEMENT DEVICE, AND NOT JUST WEARING...
...THOSE HEADPHONES SO THAT YOU CAN'T HEAR ME CONTINUOUSLY NAGGING YOU TO MOW THE LAWN...
everyday electronics
...HOW COME THERE'S NO RECORD ON THE TURNTABLE?

HEADS or TAILS

A simple electronic game.

By M.G. ARGENT

THIS unit is an electronic version of a heads and tails game, which is simple and inexpensive to build. An integrated circuit is used to simplify the construction.

CIRCUIT

The circuit is shown in Fig. 1, TR1 and TR2 form an astable multivibrator which is the timing circuit of the unit. The output from either of the collectors is a square wave as shown in Fig. 2a. The waveform is a series of square pulses where the pulse, or mark as it is known, is the same width as the space between the pulses.

The diagram in Fig. 2a is correct, as the mark and the space are of equal width. Fig. 2b is incorrect as the mark is much shorter than the space. The reason for having a 1:1 mark/space ratio is that when the output from TR2 collector is a pulse (mark), one of the lamps will light up, and when the output is at 0V (space) the other lamp will light, so the mark/space ratio **must** be 1:1 otherwise one lamp will be on longer than the other.

The square wave output is taken from TR2 collector via the spin switch (S1) to the integrated circuit IC1. The IC consists of two NAND gates wired as a bistable or memory store. A NAND gate is an electronic switch with two or more inputs and one output. When all of the inputs to the gate are at +5V, the output is at 0V. In other words the output is the inverse of the input.

To change the state of the gate, only one of the inputs need be taken to 0V, regardless of the condition of the remaining inputs, and the output will then change to +5V. In "computer language" the +5V state is referred to as a logical "1" level, and 0V is referred to as logical "0" level.

IC OPERATION

The operation of IC1 is as follows. Referring to Fig. 3, if a logical 1 level is applied to pin 9, pin 8 will go to logical 0, taking with it pin 5, this turns on LP2 and changes pin 6 to logical 1

FOR GUIDANCE ONLY

ESTIMATED COST*
OF COMPONENTS
including V.A.T.

£1.50
excluding case

*Based on prices prevailing at time of going to press

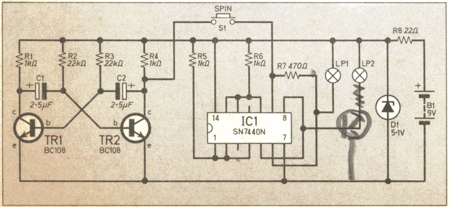


Fig. 1. Complete circuit diagram of the Heads or Tails game.

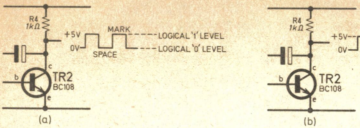


Fig. 2a. Equal mark to space ratio of a correctly balanced output (b) incorrect mark to space ratio.

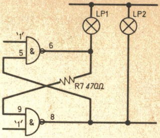


Fig. 3. Showing the wiring of the two NAND gates in IC1.

turning off LP1. IC1 will stay in this state as long as the input to pin 9 is not taken to 0V.

If pin 9 is now taken to logical 0, pin 8 will turn to logical 1, turning off LP2 and taking with it pin 5 which turns pin 6 to logical 0, turning on LP1. IC1 will now stay in this state until pin 9 is taken to logical 1.

When the spin switch is operated, the square wave output from TR2 collector, which alternates between logical 0 and logical 1 level makes the bulbs light alternately, when the spin switch is opened IC1 will stay in which ever state it was in immediately before the switch was opened.

As stated earlier, IC1 is used in this circuit as a bistable or memory store, which is a switch which will remain in whatever state (logical 1 or logical 0 level) it was left in, until it is triggered over by an input, which in this case is the output of TR2 collector via the spin switch.

The speed of the multivibrator is slow enough to appreciate the operation but too fast for anyone to follow the sequence, which would enable players to cheat. A frequency of 10 hertz was chosen to be best, and as the mark/space ratio is 1:1 there is no bias towards one lamp staying lit longer than the other.

The integrated circuit used is the SN7440N which is capable of driving low power bulbs directly, without the need for additional transistors. This IC requires a supply voltage of 5V and D1 and R8 are provided to limit the supply voltage to approximately this value.

CONSTRUCTION

All the components except the lamps and switch are mounted on a piece of 0·1 inch matrix Veroboard size 16 holes by 20 strips. The components are mounted as shown in Fig. 4, and the reverse with cutaways is also shown. The cutaways can be made with a small drill or the special spot face tool available. Care must be taken especially when soldering IC1, so as not to overheat it. If the board is clean and free from grease there should be no trouble in making a quick clean joint (an IC holder will eliminate this trouble).

The board, battery and bulbs are assembled into a small tin, in the prototype this was originally a throat pastille tin, there is no reason why any other container should not be used. The main idea is to keep the project simple and cheap to build.

As the tin used by the author was very small, no on/off switch was used, but this presented no problem as the lid can be lifted and the battery connected when required. If a larger tin is used, a switch can be incorporated in series with the battery lead. The spin switch is on a flying lead on the prototype, but again this can be built into a larger tin. The preference is up to the constructor.

Complete the unit by wiring up all the parts (S1, B1 and LP1 and 2) as shown in Fig. 4, and fitting inside the box. In operation, when S1 is pressed both lights will light rather dimly (they are only on half the time) and when S1 is released one lamp will stay lit while the other extinguishes. ■

Components....

Resistors

R1	1kΩ	R5	1kΩ
R2	22kΩ	R6	1kΩ
R3	22kΩ	R7	470Ω
R4	1kΩ	R8	22Ω

All ¼ W ± 10% carbon

SEE
SHOP TALK

Capacitors

C1 2·5μF elect. 6V
C2 2·5μF elect. 6V

Semiconductors

TR1 BC 108 silicon *npn*
TR2 BC 108 silicon *npn*
IC1 SN 7440N integrated circuit and holder to suit
D1 5·1V 300mW Zener diode

Miscellaneous

LP1,2 6V 0·06A bulbs (2 off)
S1 Push to make release to break push button
B1 9V PP9 battery and connecting clip
Veroboard 0·1 inch matrix 20 strips by 16 holes, 2 rubber grommets to hold bulbs, case (see text), connecting wire.

HEADS or TAILS

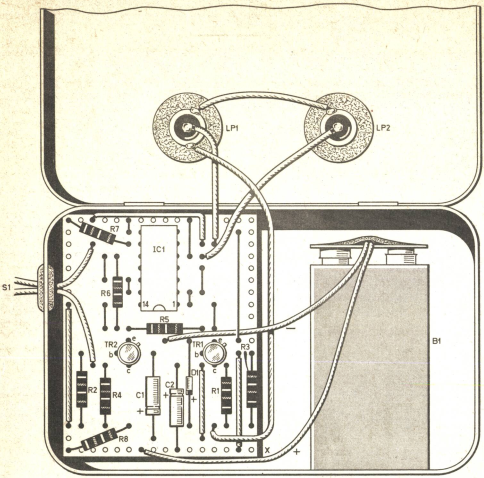
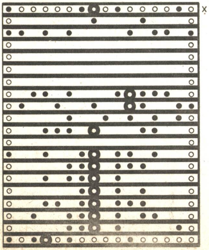
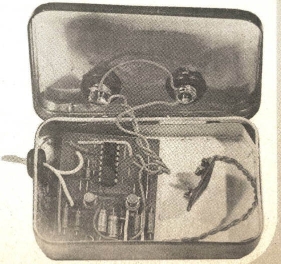


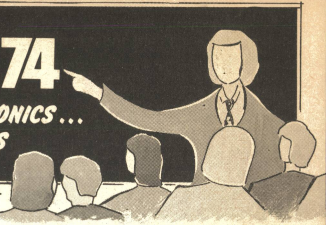
Fig. 4. Construction details of the Heads or Tails unit.





TEACH-IN '74

FOR BEGINNERS IN ELECTRONICS... THEORY AND EXPERIMENTS



TUTOR: PHIL ALLCOCK*

LESSON 11 Field Effect Transistors

So far in the Teach-In '74 series we have considered the operation of *npn* bipolar transistors in some detail and have mentioned that "opposite" polarity types, known as *pnp*, are also available. In addition to these devices a wide range of field effect transistors exists and this month we are going to examine these devices to see how they differ from the *npn/pnp* types.

TERMINOLOGY

Essentially a field effect transistor, abbreviated f.e.t., is controlled by voltage rather than current. A semiconductor material is used to provide a "channel" through which current can flow and the actual flow is controlled by the effect of an electric *field.*

This field is itself due to the presence of electric charge in a region close to the channel, known as the gate. The channel can be either *p*-type or *n*-type, depending on the semiconductor employed and in addition we have two distinct types of device known as **enhancement and depletion.**

An enhancement f.e.t. is one in which the channel is normally **off**, or non-conducting, and we must therefore apply a suitable bias to the gate to turn the transistor **on.**

The current flow in the channel is enhanced by the gate bias. In the other type the channel is normally conducting and current can be stopped by applying a suitable bias voltage.

The channel current flow is depleted by the applied bias voltage. As if this was not enough, we also find that new names are used for the connections to the ends of the channel, namely *drain* and *source,* and that there are two distinct f.e.t. families known as junction f.e.t.'s. and MOSFET's.

MOSFET

So much for the terminology—let us continue our investigation by looking at the MOSFET device in more detail.

The letters MOS refer to a field effect transistor that employs a **m**etal gate insulated by an **o**xide layer from the **s**emiconductor channel and a typical arrangement is shown in Fig. 11.1.

Starting with a piece of foundation material known as the substrate, which in this case is made of *n*-type semiconductor and therefore has free electrons, two *p*-type regions are diffused side by side into the surface.

The surface is then covered by a layer of insulating silicon oxide and two strips of metallisation are arranged to contact the *p*-type regions via windows in the oxide layer. A third metallisation strip lies on the top of the oxide, immediately over the gap between the two *p*-type regions, and forms the gate electrode.

With no bias voltage (or signal) connected to the gate, current cannot flow between the two *p*-regions, which are known as source and drain, due to the intervening *n* type region. This region effectively forms two *pn* junctions back to back, and is illustrated in Fig. 11.1.

The situation is similar to a *pnp* bipolar transistor with no connection at the base but the size of the intervening *n* region is different in the two cases.

BASIC OPERATION

If we connect the gate metallisation to a battery so that the gate is made negative (with respect to the source region) the gate will become negatively charged and the region of semiconductor immediately underneath the gate will acquire an opposite positive charge.

---

* North Staffordshire Polytechnic (*Any communications arising from the Teach-In '74 series must be addressed to Everyday Electronics, Fleetway House, Farringdon Street, London E.C.4).*

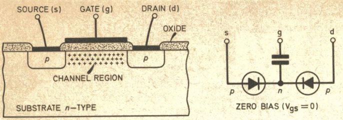


Fig. 11.1. A cross section of *p* channel MOSFET and an equivalent circuit.

In effect the electric field set up by gate repels the electrons and attracts the holes so that a "bridge" *p* type region is effectively formed which links the *p* type source and drain. Current can now flow in this *p* type channel if an external path is provided by the circuit in use.

The oxide insulates the gate from the *p* type channel and in effect behaves as a very small value capacitor. The gate current will be negligible if the oxide is free from leakage effects and the transistor therefore exhibits a very high resistance at the gate terminal.

From the description given it should be clear that the transistor considered in Fig 11.1 has the following features:

(a) Normally off with zero gate voltage.
(b) MOS construction.
(c) Channel is formed by a *p*-type region.

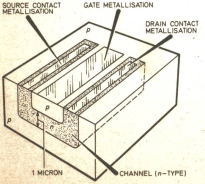
The device would therefore be described as a *p*-channel enhancement MOSFET and this type of transistor has been widely used in certain types of integrated circuits.

JUNCTION F.E.T.

An alternative method of construction for the gate region employs a "diode", which is normally kept under reverse bias and is formed by the junction between the gate region material and the channel. Such a device is illustrated in Fig. 11.2 and would be known as a junction f.e.t. or JUGFET.

All junction f.e.t's. are normally conducting at zero gate bias and are thus classed as depletion type transistors. The gate voltage must always be chosen to maintain the gate-channel diode in the reverse bias condition if correct f.e.t. operation is required.

Fig. 11.2. Typical *n* channel JUGFET. Note that the *n* type channel is surrounded by *p* type "gate" region.



The transistor used for the Tutor Board experiments is a junction type employing an *n*-type channel and the device symbol and typical bias polarities are illustrated in Fig 11.3. The current in the drain/source channel is usually called I_{ds} and varies with the gate voltage V_{gs} as shown in Fig. 11.4.

Note that the curves are similar in shape to those given earlier for the *npn* transistor, in which the base current was used for control. Two of the parameters normally listed by the manufacturer are I_{dss}, the channel current with $V_{gs}=0$, and V_{gs}(off) which is the bias voltage required to cut-off the channel (or reduce the current to some specified low value).

As might be expected the manufacturer usually quotes a range for each parameter and in the case of the 2N3819 the values are:

$$I_{dss}=2 \text{ to } 20\text{mA}$$
$$V_{gs}(\text{off})=8\text{V (maximum)}$$

The alternative names, pinch-off or threshold voltage are sometimes used instead of V_{gs}(off) but it is more usual nowadays to reserve the term threshold voltage for the voltage level at which enhancement MOS devices start to turn-on.

Fig. 11.3. (left) Symbol for *n* channel JUGFET. All polarities and "arrow" on gate lead are reversed for *p* channel device.

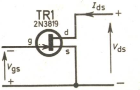
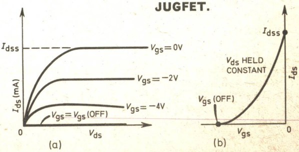


Fig. 11.4. Characteristics for *n* channel JUGFET.



DIFFERENCES

The most obvious difference between the BC107 *npn* bipolar transistor and the 2N3819 *n*-channel JUGFET is the very high input resistance of the latter device which can be of the order of 1,000 megohms. Thus if we require a circuit having a very high input resistance it would be wise to consider a field effect transistor for the intended application.

The Tutor Board experiments this month include one circuit which utilises the high input resistance feature of the 2N3819. Whilst on the subject of high input resistance it is worth mentioning that **MOS devices can be damaged if the gate electrode acquires a static charge** which causes the gate breakdown voltage rating to be exceeded.

The gate capacitance is usually very small, typically a few pF, and since V=Q/C, a small charge can easily give rise to excessive voltage.

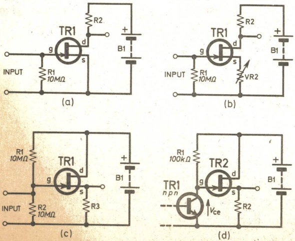
MOS transistors are often fitted with a small wire clip or spring which shorts all connections together. These clips should only be removed *after* the transistor has been connected to the external circuit. Since a thin oxide layer is not used for making the gate of a JUGFET these problems do not occur but the manufacturers ratings should not be exceeded.

JUGFET BIAS CIRCUITS

To become more familiar with field effect transistors let us look at some of the circuits that can be employed. Fig. 11.5 shows several ways of arranging the necessary gate and drain supplies for the 2N3819 *n*-channel JUGFET.

Notice that in each case the drain is connected to the positive supply terminal and I_{ds} will flow into the drain terminal and out at the source terminal (conventional current assumed). In Fig. 11.5a the gate and source are connected via a relatively high value resistor (10 megohms) but since the gate leakage current is normally very small no voltage drop occurs across R1.

Fig. 11.5. Some "bias circuits" for an *n* channel JUGFET (a) Common source circuit with $V_{gs} = 0$. (b) Common source circuit with self bias (V_{gs} negative). (c) Source follower circuit. (d) Source follower fed from *npn* transistor stage.



Consequently $V_{gs}=0$ and the drain circuit current will be approximately I_{dss} providing R2 is not too large. Since the parameter I_{dss} has a very wide spread of 2-20mA the drain current is not very well defined by this circuit and will vary from one transistor sample to another.

In Fig. 11.5b a resistance (VR2) is included in series with the source lead and gives rise to a voltage drop of magnitude:

$$\text{Voltage across VR2} = (\text{VR2}) \times I_{ds} = -V_{gs}$$

Since I_{ds} depends on V_{gs} as shown in Fig. 11.4b the circuit tends to compensate partly for variation of I_{ds} between transistor samples. For example, if I_{ds} "tries" to increase by say 1mA and we assume that VR2 was set at one kilohm this would give an increase in the magnitude of V_{gs} of one volt. Since this V_{gs} change will tend to *reduce* the current I_{ds}, the final change in current is less than it would be with VR2 not fitted.

To calculate the actual working current is slightly complicated by this feedback action and in practice we can make VR2 variable and adjust the resistance to give the required working current which must of course be less than the transistor I_{dss} value for the sample used. (If the manufacturer's curve of I_{ds} against V_{gs} is available it can be used to work out the bias point.)

The circuit shown in Fig. 11.5c gives the field effect transistor equivalent of the usual emitter follower circuit and in this example the voltage at the gate will be one half the power supply. The circuit requires R3 to be greater than $\dfrac{V_{ds}}{2\ I_{dss}}$ if correct operation is to be achieved. Fig. 11.5d is similar to (c) except that the gate voltage is determined by the bias arrangements for the *npn* stage. In this circuit R2 must be greater than $\dfrac{V_{ce}}{I_{dss}}$ for correct operation.

VOLTAGE CONTROLLED RESISTANCE

By operating a field effect transistor at low V_{ds} voltages, typically less than 500mV, the transistor can be used as a voltage controlled resistance. The effective resistance of the channel depends only on V_{gs}, providing the drain/source voltage is kept small, and actually corresponds to operation at (or near) the origin of the characteristics shown in Fig. 11.4a.

This principle can be employed as an electronic "volume control" by arranging the transistor as one part of a potential divider system. The principle is illustrated in Fig. 11.6 which is

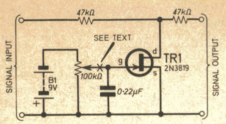


Fig. 11.6. Experimental electronic volume control.

suitable for experimental purposes providing input signals of less than a few 100mV are used.

The transistor is effectively open circuit when $V_{gs}=-9$V and the input signal can then pass directly from input to output. The signal will suffer some attenuation depending on the load resistance connected at the output.

For a load of 100 kilohms the maximum output signal will be about 50 per cent of the input. If this circuit is used in place of a conventional carbon track volume control a noise free control is achieved.

The 0·22µF capacitor acts as a filter to remove any noise produced by the adustable 100 kilohm bias-voltage control. Additional filtering can be provided if necessary, by including an extra 100 kilohm fixed resistor at point X.

Next month we shall examine the action of the thyristor and give some simple tests based on the type BTX 30-25. (The components list April '74 issue gave the BTX 30-25 as a triac—it should have read thyristor).

TUTOR BOARD EXPERIMENTS

Test No. 22. Measurement of f.e.t. parameters.

Low cost field-effect transistors are usually wide tolerance devices and in this test we illustrate some simple measurements that can be made to determine the I_{dss} parameters of a typical sample.

Set up the circuit shown in Fig. 11.5a on the Tutor-Board, but make R1 zero by shorting the gate and source connections with a wire link. (The 2N3819 transistor should be mounted in the same manner as that used for the BC107. The connections are shown in Fig. 11.7.)

Use a fixed 100 ohm resistor for R2 and 9V for the supply. Set up the standard 0-10 volt voltmeter circuit and measure the voltage across R2. From this reading it is possible to calculate I_{dss} since:

$$\text{Voltmeter reading (in volts)} = \frac{I_{dss}(\text{mA}) \times 100}{1000} = \frac{I_{dss}(\text{mA})}{10}$$

For example, a reading of 1·5 volts would correspond to $I_{dss}=15$ mA. If the voltmeter reading is too small to observe accurately, the range of the voltmeter can be reduced to 0-1 volt by using a 10 kilohm ±5 per cent resistor in *parallel* with the normal 100 kilohm ±2 per cent meter resistor. With this modification it is only possible to cater for I_{dss} values up to 10 mA.

Test No. 23.

This test demonstrates the very high input resistance at the gate terminal of the 2N3819. The circuit is shown in Fig. 11.8 and should not present any layout problems on the Tutor-Board.

The potentiometer VR2 is set to mid-position (approximately) and the switch is closed after setting VR3 for maximum resistance. Except for the capacitor the circuit is now similar to Fig. 11.5c.

The capacitor will rapidly charge up to the voltage level determined by the setting of VR2 and a reading should be apparent on the meter. The meter can be set to full scale deflection by adjustment of VR3.

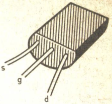
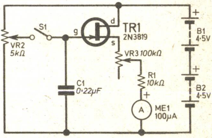


Fig. 11.7. Connections for 2N3819.

Fig. 11.8. Capacitor discharge observation circuit, VR3 should be set for maximum resistance before connection of batteries.

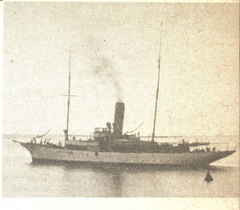


If the switch is now opened the capacitor can only discharge via the high input resistance of the f.e.t. and the capacitor leakage paths. The very slow discharge will be apparent by the slow fall in meter reading.

The circuit is a source-follower with the meter reading the current flowing in the source resistance. As the gate voltage falls due to the capacitor discharge the transistor current also falls.

"Stan's still having trouble with the practical side of his electronic devices."

Left. Marconi in the laboratory of his yacht *Elettra*, pictured beside a high power short wave transmitter. (*Marconi*)



Marconi's steam yacht *Elettra*, fitted with extra topmasts for aerial height. (*Marconi*)

Centenary of an Amateur

Marconi 'Father of Wireless'

By Bill Maconachie

IN this centenary year of the birth of Guglielmo Marconi a great deal has already been written about his inventive genius, portraying him—rightly enough—as the founder of a great industry and of great companies. But there was a side to his personality about which little has been said, and this is perhaps best illustrated by a remark he made in 1933 when he visited the World Fair in Chicago.

One of the features of the exhibition was an amateur radio shack. Marconi called in, introduced himself, and was shown over the station with, one can imagine, a mixture of pride and embarrassment on the part of the man who had built it. Marconi congratulated him on his workmanship and he modestly replied that of course he was only an amateur. "Yes," said Marconi. "But then I am only an amateur myself".

That remark was in all probability not prompted by false modesty, for Marconi's character indicates that while in no way a boaster he nevertheless always had a proper sense of his own achievements. To say that he was an amateur was no more than a simple statement of fact. He began as an amateur, and an amateur he always remained until his death in 1937.

His first attempt at communication was in the Villa Grifone at Pontecchio, near Bologna, shortly after ten in the morning on Saturday, 25th April, 1874. There was nothing special about it, for it was no more than the wail common to all newborn babies and no doubt it didn't carry very far, anyway. Far enough, though, to delight his Irish mother Annie, the daughter of Andrew Jameson of County Wexford and whiskey fame, and to stop the pacing of his father Giuseppe.

EARLIEST EXPERIMENTS

There was nothing special about his early boyhood either, but very soon he developed a fascination for electricity, and before he was ten he had started reading about it and experimenting with its effects.

Precocious, you might think, but then he had no formal schooling and, except for his brother Alfonso who was nine years older, lacked the company of other boys and their interests. His mother had taught him to read and write, and he found books on electricity of absorbing interest. For his crude experiments he used whatever materials he could lay his hands on, and among his domestic acquisitions was a set of dinner plates which he decided would come in handy as insulators for a high-voltage line across a stream near the house. The result was disaster.

The plates were smashed. To Marconi's father Giuseppe, a man in the old Victorian *paterfamilias* mould, mean almost to the point of miserliness, this was senseless destruction of valuable property, and from that day on he systematically demolished any bits of the boy's apparatus he found around the house. Annie, however, stood up for her son and eventually a sort of armistice was reached and young Marconi was given the run of the attic floor of the house where his grandfather Domenico kept trays of silkworms. In their silent company he was allowed to dabble undisturbed.

STATIC ELECTRICITY

When he was thirteen the family took an apartment in Leghorn for the winter and young Marconi attended the Technical Institute there, for the first time receiving some real education in electrophysics. He rigged up a zinc contraption on the apartment roof and succeeded in using the charge of static electricity it built up during a thunderstorm to ring a bell downstairs. And he met an old telegraphist named Nello Marchetti who taught him the Morse code.

There were distractions, two of them deliberately arranged by his father who opened his purse to buy the boy a small sailboat and to pay for piano lessons. Young Marconi learned to sail and to play the piano rather well, and developed a passion for music, but he kept returning to his electrical experiments though for some time these seemed to have no definite aim more than the satisfying of his curiosity.

Then in January, 1894, Heinrich Rudolf Hertz died and shortly afterwards Marconi read an article by Augusto Righi on the work of Hertz. He was fascinated by the account of the "Hertzian rays" and from that point on his hitherto rather aimless dabbling had a firm goal, the transmission of electrical signals without connecting wires.

FIRST WIRE-LESS SUCCESS

Back home in the attic of the Villa Grifone he worked ceaselessly, far into the night, and his mother's reward for the earlier encouragement of her son came one night when she was asleep. It was almost midnight when her twenty-year-old son woke her and asked her to come up to the attic. There she watched while he pressed a Morse key and at the far end of the attic a bell rang. There was no wire, no thread, connecting the key and the bell. Twenty-year-old Guglielmo Marconi had sent electrical impulses through the air.

That was his big breakthrough, though only domestically at first. Father Giuseppe at last, if somewhat grudgingly, admitted that there might just be some practical use for his son's dabbling, and even handed over a little cash to buy more materials. Marconi improved his apparatus and was able to send signals to the other side of a little hill close to the house. Details of the invention were then sent to the Italian Ministry of Posts and Telegraphs, but Signor Sineo, the Minister, turned down the offer without even asking for a demonstration.

OFF TO LONDON

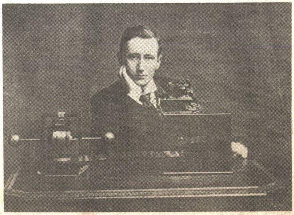
It must have been a big disappointment, not only to young Marconi but doubtless also to his father who had viewed his cash contribution as an investment and was looking for a return on it. However, Annie Marconi was not to be beaten. Believing that Britain, in those days the world's foremost maritime nation, might see the value of the invention for communicating with ships at sea, she obtained a letter of introduction to W. H. Preece, engineer in chief of the British Post Office, and armed with this set off with her son for London in February, 1896.

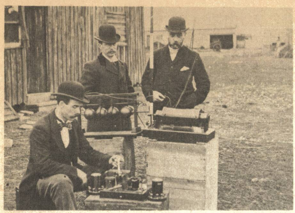
Preece was himself an experimenter in new methods of telegraphy transmission but had had little success with his attempts at using inductive techniques, and he gave the young Italian his support, introducing him as a "surprise guest" at the end of a lecture he gave at Toynbee Hall in December, 1896.

You can perhaps picture this shy, reserved young man walking on to the platform to face his first scientific audience, carrying his home-made apparatus that the Press was soon to call "the mysterious black box", and giving a demonstration of its capabilities while almost certainly praying inwardly that nothing would go wrong. But it worked, even though Marconi carried his black box about the hall to show that there was no deception, and next day the papers carried headline stories about the Italian inventor.

Of course there were sceptics in plenty. Even Lord Kelvin said that so far as sending a message by wireless was concerned he would sooner trust a boy on a pony. And there were others who, while admitting the truth of what

Marconi in London in 1896 with the original apparatus he brought from Italy including the "mysterious black box." (*Marconi*)





A group of Post Office officials keenly interested in Marconi's hook-up for the first successful transmission across water from Lavernock to Brean Down in 1897. *(Marconi)*

they had seen in Toynbee Hall, would not believe that signals could ever be sent over any substantial distances. As for sending them across water—well, everybody knew that water absorbed electricity from the air, so that was a non-starter.

TRANSMISSION ACROSS WATER

But Marconi proved that he could send signals for considerable distances out of doors, and in May, 1897, confounded those who thought that water would be a barrier by transmitting across nearly nine miles of the Bristol Channel between Brean Down and Lavernock.

That was proof enough for everybody, including even Lord Kelvin who became an enthusiastic convert. Willing financial backers took up the young inventor and the ardent amateur found himself swept into commercialism with the formation of the world's first wireless firm, the Wireless Telegraph and Signal Co., Ltd.

Orders came in from Lloyd's to equip their signal stations for the reporting of passing ships soon after the company was formed on 20th July, 1897—a day, incidentally, when, however important it must have been in Marconi's life, he had actually returned to Italy to demonstrate his apparatus to the Italian Navy which proved much more receptive than that country's postal authorities had been three years earlier and immediately decided to adopt wireless for its ships.

In fact, Marconi's absence from London on the day the company was formed is a pointer to his character. He was always happier at a laboratory bench than behind a desk—always the devoted dabbler with bits of wire rather than the complete business man, an amateur in the truest sense of the word. But he was, too, always a shrewd user of publicity.

ROYAL PATRONAGE

An opportunity for this came his way in 1898 when the then Prince of Wales—later to become King Edward VII—was convalescing on board the Royal yacht *Osborne* off Cowes after an injury, while Queen Victoria was in residence at Osborne House. Since intervening hills made visual signalling between the yacht and Osborne House impracticable, the Queen decided to give the new wireless a trial and have sets installed on board the *Osborne* and at Osborne House. During the next fortnight or so 150 messages were exchanged, with full reporting of the Prince's progress in the newspapers.

Incidentally, there is a story—possibly apocryphal—told about this, in which Marconi, summoned by the Queen, arrived at the front door of Osborne House and sent in his name, but was told to report at the tradesmen's entrance. He refused, and the Queen is said to have commanded "Send for another electrician." No other electrician of his calibre, however, was available, and no doubt the incident ended amicably.

BUSINESS DEVELOPMENTS

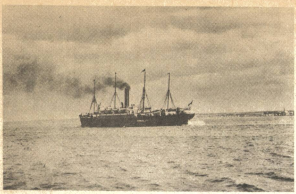
In the meantime the new company's affairs were progressing, but slowly, most of its business being with the British government, Army, and Navy, all of which showed great interest but did not come forward with much in the way of firm orders. Marconi himself seemed to care deplorably little for the interests of the shareholders—as long as the company could provide money for further experiments he was happy.

The other directors, however, did not share this attitude and a decision was taken—Marconi's being the only dissenting vote—to reconstitute the company as Marconi's Wireless Telegraph Co., Ltd., in order to capitalise on his name. That was in February, 1900, and two months later Marconi took out his patent No. 7777 for the first method of tuning transmitters and receivers. This was a great step forward since until then transmissions had been untuned over a very broad frequency band and selection of stations to be received had been impossible.

Although Marconi's original idea had been to use wireless to end the isolation of ships at sea, no commercial orders for installing it on ships had been received in the first three years of the company's existence. The breakthrough came with the fitting—not of a British ship—but of the Norddeutscher Lloyd lines *Kaiser Wilhelm* in February 1900.

That April a second company, the Marconi International Marine Communication Co., Ltd., was formed to hire equipment to ships since, under the terms of the Telegraph Acts of 1868 and 1869, the Post Office had a virtual monopoly of all telegraph traffic and if shipping companies had bought their installations each would have had to set up its own coast station.

In May of the following year, 1901, the *Lake Champlain* became the first British ship to be



The liner *Lake Champlain*, in 1901, was the first British merchant ship to be commercially fitted with wireless. (*Marconi*)

commercially fitted, and soon after Cunard, with their *Campania* and *Luciana* followed suit. Marconi had built a powerful transmitting station at Poldhu, in Cornwall, to handle Transatlantic traffic to ships, and once this was in operation other passenger-carrying ships began to install apparatus. Then Marconi was off again, this time to St. John's in Newfoundland to put up a station there and prove that communication right across the width of the Atlantic was possible. He did it, and in 1902 a permanent station was established at Glace Bay.

OTHER GREAT INVENTIONS

During the period up to the first World War Marconi and the team of like-minded men he had gathered around him—inquisitive engineers as distinct from the office staff—were busy indeed. Marconi himself devised and patented the magnetic detector to replace the inefficient coherer; Dr. J. A. Fleming, scientific adviser to the company, developed the diode (later improved by Lee de Forrest by the addition of the grid) and the directional aerial, another Marconi idea, was brought into use at Clifden in Ireland where a new station had been erected to replace Poldhu.

This period also saw the first use of wireless in the air, first in communication with a captive balloon and then, in 1910, with an aeroplane. In 1910, too, its use in the capture of the murderer Crippen captured the public imagination, and its value in bringing help to a ship in distress was demonstrated to the world in 1912 when the *Titanic* sank, even though on that occasion assistance arrived too late to save all on board.

Marconi's fertile mind, too, was demonstrated in the course of his evidence at the enquiry into the loss of the *Titanic* when he said that he was considering the feasibility of an instrument that would ring a bell on ships within range of a vessel in distress—the germ of an idea that he was later to develop into the auto-alarm receiver which is compulsory equipment on most single-operator ships today.

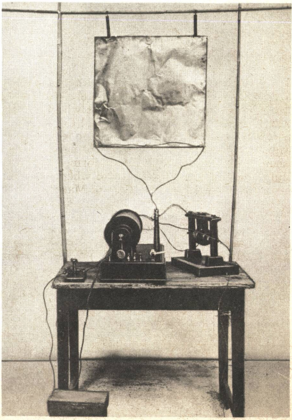
AIR TO GROUND RADIOTELEPHONY

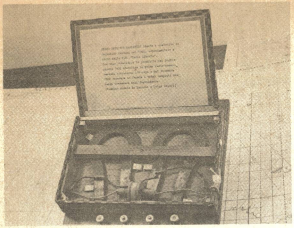
He had also been intrigued by what he called "the directional effect of wireless emissions" and acting on his observations another of his team, Captain H. J. Round, did a great deal of work in developing the direction-finding receiver which in the 1914-18 war enabled Britain to monitor the movements of German warships and led to the Battle of Jutland. Round and two other colleagues, Prince and Furnival, also overcame the problems of air-to-ground radiotelephony and plane-to-plane telephony, the latter being achieved in 1917.

Radiotelephony became broadcasting in 1920 with two events.

One was when the delegates to the Imperial Press Conference, travelling to Canada on the liner *Victorian*, heard a concert of gramophone records broadcast from Chelmsford, 1,000 miles away—Marconi's flair for publicity again. The other was the first advertised broadcast, a song recital by Nellie Melba in an improvised studio at Marconi's Chelmsford works.

A simulation of Marconi's early experimental transmitter using a copper sheet aerial, induction coil and spark gap. The coil seen in this replica assembly is, however, of much later date and is in fact a production model of a type used for a number of years after 1900. (*Marconi*)





The handiwork of an amateur. Marconi used a cigar box as a case in which to build his first magnetic detector while experimenting on board the Italian warship *Carlo Alberto* in 1902. (*Marconi*)

A little over a year later the Marconi company was licensed for regular broadcasting and opened the 2MT station in an ex-army hut at Writtle, and a licence was also granted for the original 2LO London station at Marconi House in the Strand. Later still, in 1922, the Marconi company was one of six which formed the British Broadcasting Company, superseded in 1926 by the British Broadcasting Corporation.

SHORT-WAVE EXPERIMENTS

Marconi himself, though, took little interest in the development of broadcasting. It presented no real technical challenge to him, and as he once said when tackled on the subject, "Can you compare entertainment with the saving of men's lives?" In 1920 he had bought a steam yacht which he named *Elettra* and fitted out as a floating laboratory, principally to work on investigations into short-wave transmissions in pursuit of one of his greatest personal ambitions, the linking of all the countries of the British Empire by directional short-wave.

In the course of his experiments with short-wave techniques he noticed, as he said in a speech he gave in New York in 1922, "that short-wave transmissions were subject to reflection by metallic objects many miles away." He went on to say "It seems to me that it should be possible to design apparatus by means of which a ship could project a beam which would be reflected back and reveal the presence and bearing of another ship in fog."

Evidently the principle of radar at least existed in Marconi's mind at that time, but being preoccupied with his grand project of the Imperial Wireless Chain he did not pursue the idea and it was left to Sir Robert Watson Watt to give Britain the invaluable lead in radar for World War II, though Marconi did return to thoughts of it shortly before his death.

The Imperial Wireless Chain project almost came to fruition and in fact Marconi had a contract for the setting up of the necessary stations practically within his grasp in 1924. But cable companies throughout the British Empire, seeing their business threatened, brought influence to bear with their respective governments with the effect that their interests were merged with the Marconi scheme and control was vested in a new organisation, Cable and Wireless, Ltd.

WITHDRAWAL FROM BUSINESS LIFE

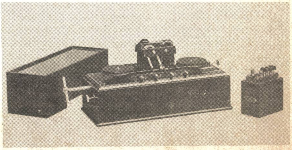
Sorely disappointed and plagued by increasing ill-health, Marconi withdrew more and more to his home in Italy and to life at sea on board the *Elettra*. Business life, that had never really meant much to him, was put aside pretty well completely, and most of his time was spent as it had been in his youth, experimenting and trying out new techniques.

He did a great deal of work on microwave transmission, leading up to the creation of the first microwave radiotelephone link in 1932. Then in 1935 he took up his radar idea again and was able to construct a working model and demonstrate it in principle. His health, however, was failing rapidly and in the early months of 1937 he suffered three minor heart attacks. He had a fourth and major attack on 19th July that year and died early the following morning at the age of 63.

THE FINAL TRIBUTE

All his life Guglielmo Marconi had had honours and distinctions bestowed upon him, but none could have been matched by the world's tribute on the day of his funeral in Rome when radio and broadcasting stations all over the world closed down for two minutes from 6 p.m. and the "ether" was for a brief period again as silent as it had been before that midnight in the attic of the Villa Grifone at Pontecchio. ▣

When the magnetic detector went into production it was a much more elaborate affair with a clockwork motor to drive pulleys causing a band of soft iron to rotate through the magnetic field. In a handsome mahogany case, it had a glass-topped lid to keep out dust. (*Marconi*)



We would like to thank The Marconi Company Ltd., for the photographs used in this article.

NEXT MONTH!!

for you to construct

...A METAL LOCATOR

A straightforward design that is inexpensive and easily constructed, this metal locator will provide hours of entertainment and could provide some valuable finds.

A 2WAY IN-HOUSE COMMUNICATOR

A communication system for your home—no more shouting at father in the garage, simply call him up and request the pleasure of his company.

AND...A SIMPLE CRYSTAL SET

A very simple m.w. crystal set, with improved selectivity, that can also be used as a simple tuner. This neat unit has been designed for ease of construction.

PLUS ALL THE REGULAR FEATURES

Because of prevailing production problems, no firm publishing date can be announced for the September issue. Readers are advised to check regularly with their local supplier from mid-August onwards.

everyday electronics

KNOW YOUR COMPONENTS...

Hints & Tips for the Novice Constuctor

By Ron Adams

The Capacitor

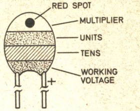
This device normally has its value printed on its body, but many lower value capacitors are colour coded like resistors, see below. Remember, if in doubt—check it out. Remember also that electrolytic and solid tantalum capacitors are polarised—make sure that they are inserted in circuit the right way round.

If the electrolytic body is not marked with polarity, a good tip to bear in mind is that the negative lead is usually connected to the case.

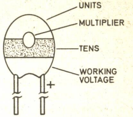
Tantalum bead capacitors can be tricky. They are those capacitors that look like frogs eyes on wires. The way to identify the positive lead on this component is to hold the capacitor with the dot facing you with its wires facing down; the positive lead is on your right hand.

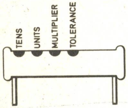
Remember that voltage ratings are important, but obviously a 50V capacitor can be put in place of a 25V capacitor. Again the rule is "up, not down".

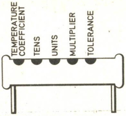
SOLID TANTALUM TYPES



WHEN VIEWED WITH SPOT SHOWING POSITIVE LEAD IS AS MARKED



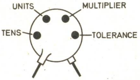




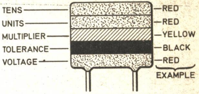
5 DOT COLOUR CODE

CERAMIC TYPES

4 DOT COLOUR CODE HAS THE SAME SIGNIFICANCE AS FOR C280 TYPE



MULLARD C280 POLYESTER TYPE



EXAMPLE:—

CAPACITANCE = 22 x 10 000pF
= 220 000pF OR 0·22μF
TOLERANCE = ± 20%
VOLTAGE = 250V

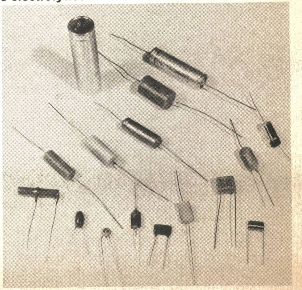
CAPACITOR COLOUR CODE
As Used For Mullard C280 Series and Ceramics

Colour	Tens & Units	Multiplier	Tolerance	Voltage
Black	0	x 1pF	±20%	—
Brown	1	x 10pF	±1%	—
Red	2	x 100pF	±2%	250V
Orange	3	x 1,000pF	±2·5%	—
Yellow	4	x 10,000pF	—	400V
Green	5	x 100,000pF	±5%	—
Blue	6	—	—	—
Violet	7	—	—	—
Grey	8	—	—	—
White	9	—	±10%	—

CAPACITOR COLOUR CODE
As Used For Tantalum Capacitors

Colour	Voltage	Tens & Units	Multiplier
Brown	—	1	x 10μF
Red	—	2	x 100μF
Orange	35V	3	—
Yellow	6·3V	4	—
Green	16V	5	—
Blue	20V	6	—
Violet	—	7	—
Grey	25V	8	x 0·01μF
White	3V	9	x 0·1μF
Black	10V	0	x 1μF
Pink	35V	—	—

Below right. Photograph of a selection of most of the common types of capacitors including some electrolytics



EXPERIMENT IN HEADPHONE STEREO

An experimental circuit designed to improve the stereo effect when using headphones.

By H.T. KITCHEN

FOR many people, stereo listening via headphones is the norm, either because of circumstances or because of personal preference. Others, like myself, may have a single large lounge which houses both the stereo and the family television set, and here the conflicting demands of both services requires careful and skilful manoeuvring by the head of the house if chaos is not to reign unchecked. However, as the saying sayeth, there is many a slip!

Both wife and seven-year-old daughter failed to recognise the advantages of listening to TV via "phones"; stalemate! Realising that "A Family at War" and "Top of the Pops" had won the day, and that there was a danger of dad's classics suffering from instant silence, I withdrew from the fray and started investigating headphones, dad for the use of.

Not knowing if I would like headphone stereo, I decided to invest in a modestly priced pair, and a short "demo" on mono f.m. radio ended in my purchasing a pair of Eagle SE40's, together with the appropriate shorting socket and a 5 metre extension. (I like conducting Beethoven whilst walking about.) The problem of attaching the 'phones to the Quad II's was on.

Early experiments were encouraging, the sound level and quality from the SE40's being higher than expected.

MATCHING

A straight changeover from 'speakers to 'phones wasn't liked, the apparent volume levels being too dissimilar, plus the difference in the "central" positions. I decided to try and equalise things. Fig. 1 shows the first attempt at equalising the apparent sound levels, and at providing a balance control that was operative on 'phones only, permitting the Quad pre-amp balance control to be used as a master balance control.

A switch, S1a and S1b was added, this being mounted on the front panel to select 'speakers or 'phones. A rotary 6 pole 2 way switch was used, three pairs of poles being connected in parallel to reduce contact resistance. At low

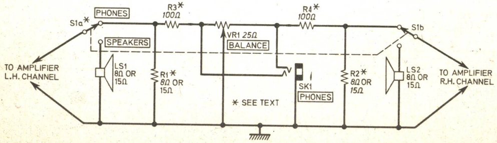
FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS
including V.A.T.

£3.50
excluding case

*Based on prices prevailing at time of going to press

Fig. 1. Basic equalisation and balance circuit.



levels, the oxide layer that inevitably builds up, can act as a rectifier, setting up distortion. Three pairs of switch contacts should assist in reducing contact resistance.

Resistors R1 and R2 are 15 ohm 10 watt components, and substitute for the 'speakers when 'phones only are required. The Quad power amplifiers are tolerant of varying loads, but this should not be taken as an excuse for haphazard "matching". Also, other amplifiers may not be so tolerant, and may suffer consequential damage.

Resistors R3 and R4 are series resistors, subjectively selected to provide approximately equal sound levels when the 'phones are substituted for the 'speakers. The variable resistor VR1 is the balance control. Various resistance values were tried; the 25 ohm resistor gave the best subjective results. Its operation will be obvious.

We now have a circuit which allows one to change from 'speakers to 'phones without a drastic change in the apparent volume levels, and which allows one to set the central image independently.

So far, so good. The family at war is now, domestically speaking, a family at peace. Dad can enjoy his stereo again, albeit his head feels as if it had been firmly clamped in a vice after an hour or so! The sound quality is astonishingly good for such an inexpensive pair of 'phones, even after the initial enthusiasm has worn off.

But wait, and listen, all is not well! The sound quality hasn't altered, but something is amiss. Ahah! I have it! Half the orchestra are on my left, and the other half are on my right. There is very little in front.

SOUND STAGE

The "fault" does not lie in the equipment. Rather it is the way in which we hear that is the cause. Normally, a sound source directly in front can be identified as being in front, even if the eyes are closed, if both ears have similar characteristics. A sound to the right or to the left can similarly be identified, simply because the brain translates direction in terms of the difference in time taken by the sound to reach each ear.

If a sound takes a millisecond or so less to reach the right ear, than it does the left, then that sound is identified as being to the right of centre; the reverse also applies.

The sound stage, with 'speakers, cannot be wider than the spacing between the 'speakers, though reflections from suitably (!) placed walls sometimes opens up the image a little. As a consequence, the sound angle is restricted, 90 degrees being about average. The experts' recommendations cannot always be adhered to, because of circumstance, or are not adhered to, because of personal preferences. One demonstration I recently attended (I shall spare the agent's blushes) had the 'speakers at an angle approaching 160 degrees for the front row. Talk about a hole in the middle!

With 'phones, the ears are completely isolated from one another, and since they are set on apposite sides of the head, a stereo signal will apparently originate on opposite sides of the head, whilst a correctly phased, centralised, signal will apparently originate in the centre of the head. Subjectively, the results can be amusing, bewildering, or irritating. The end result is almost always listening fatigue, and it is worth trying to find even a partial cure, if not a complete cure.

Narrowing of the sound stage can be effected by feeding part of one signal into the other, i.e. part of the right hand 'phone signal to the left hand 'phone, and vice versa. Quite elaborate circuits exist for this purpose, but it was decided to try and see if something simpler would not provide reasonable results. Fig.2 shows the second attempt at improving headphone stereo, ignoring VR3 and C1 for the moment, VR2 is connected across VR1 and functions as the sound width control. At maximum resistance, its effect upon the apparent sound width is negligible.

As the resistance in circuit decreases so the sound stage narrows, until its resistance is zero, when the sound, being fed to two 'phones in parallel, produces a mono image. All other factors being equal, this will provide a central image within, apparently, the listener's head. Although somewhat crude, this method works reasonably well, and is worth experimenting with.

FREQUENCY SELECTIVE SYSTEM

The drawback to the simple circuit of Fig. 2 is that it compresses the sound stage willy nilly. An extension of this scheme is to introduce frequency selective sound stage narrowing, and this is effected by VR3 and C1.

Components....

Resistors

R1 15Ω 10W } (or to suit amplifier output
R2 15Ω 10W } resistance e.g. 8Ω 10W)
R3 100Ω 1W } (selected on test—see text)
R4 100Ω 1W }

Capacitor

C1 8μF metalised polyester (4 × 2·2μF)

Potentiometers

VR1 25Ω wirewound
VR2 50Ω wirewound
VR3 50Ω wirewound

SEE
SHOP TALK

Miscellaneous

S1 6-pole 2-way rotary switch (see text)
SK1 Standard stereo jack socket to suit phones
Case, connecting wire, 4 knobs

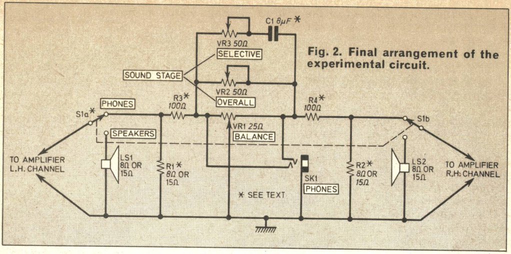


Fig. 2. Final arrangement of the experimental circuit.

The reactance of a capacitor is, as is well known, $1/2\pi fC$, C being in Farads, and f in Hz. The reactance of a capacitor is inversely proportional to frequency, i.e. it is halved for every doubling of frequency. As far as this particular application is concerned, all this means is that C1 will offer a reduced resistance to the higher frequencies, so reducing the apparent sound stage for the increasing frequencies.

Assuming VR2 is out of circuit, the low frequency instruments of an orchestra will occupy the extremities of the sound stage, with the higher frequency instruments progressively occupying the central portions of the sound stage.

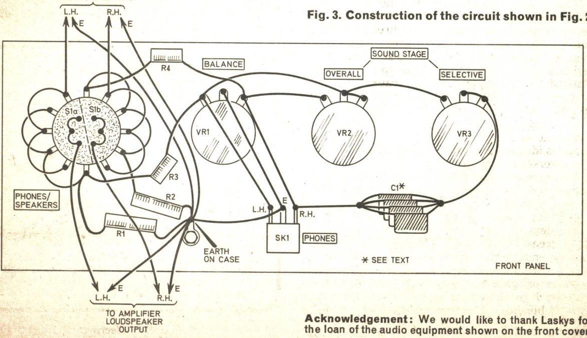
A theoretical objection to this scheme is the shrinking/expanding piano. Theoretically, this will "move" as the pianist's fingers move across the scales. So too will other wide range instruments or vocalists. This theoretically undesirable effect does not, in practice, appear to obtrude excessively. This is probably due to the fact that the full range is only rarely used at any one time.

The circuits given should, perhaps, be best regarded as being of an experimental nature, to be varied and expanded upon by the individual. The cost, in terms of coin of the realm, is low. Time is the major ingredient, and should, at the very least, lead to a greater understanding and appreciation of stereo via headphones.

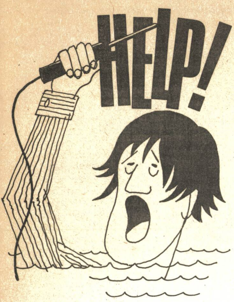
Capacitor C1 can be made up of four 2·2μF polyester types in parallel—variation of the overall value for experiment is then possible.

A constructional diagram for the circuit of Fig. 2 is shown in Fig. 3. Mount S1 and VR1 to VR3 in a suitable case and wire up as shown. ■

Fig. 3. Construction of the circuit shown in Fig. 2.



Acknowledgement: We would like to thank Laskys for the loan of the audio equipment shown on the front cover.



Decoupling

Can you tell me why one often sees a high value capacitor connected across the power lines of a circuit—even though the circuit is run from batteries and there is no smoothing problem?

These capacitors come into the general category of *decoupling capacitors* and they are usually included for one of two reasons. Some circuits draw modest current from a battery under normal circumstances but may occasionally require a brief surge. If this surge is too great the internal resistance of the battery might cause the output voltage of the battery to fall momentarily and this could upset the biasing of other parts of the circuit and lead to distortion—worse still the drop in supply voltage might act as a signal to an earlier stage of the circuit and low frequency oscillation (instability) might ensure.

The capacitor—straight across the supply rails—acts as an extra source of current when this condition arises; the charge stored within it, during normal running, is withdrawn during the current surge and this compensates for the limiting effect of the battery's resistance. This technique is only valid for short duration surges because time has to elapse for the capacitor to regain its charge between them.

Many amplifiers have a capacitor connected between the supply rail and ground near the pre-amplifier stage—usually on the pre-amp side of a resistor in the power rail. This has a similar function. When the output stage of the amplifier is drawing peak current there is always a slight drop in supply voltage (it may only be a few millivolts) and this could act as a signal into the input stage—by reducing the collector current of an early transistor. The capacitor and series resistor in effect filter out the slight supply variation.

A.C. and D.C. Coupling

I am a bit confused by the terms a.c. coupling and d.c. coupling. Can you help?

If one applies a constant current (from a d.c. voltage source) into the base of a transistor the collector voltage will take up a fixed level and will stay there as long as the base current is maintained. If the collector voltage of this stage is directly coupled to the base of a following stage (either through a resistor or by direct connection) then the output of the second stage will follow suit and will stay in the new condition for as long as the original input current is maintained. This is d.c. coupling.

If, however, the voltage at the collector of the first stage is incompatible with the biasing of the second we have to provide isolation from the fixed voltage. This is done by putting a capacitor (or transformer) between the stages and then we have to provide suitable bias for the second stage.

The base current (provided by the input signal) for the second stage will vary only when there are changes in the collector voltage of the first; at the end of the "change" the output of the second stage will always revert (possibly after a bit of time) to its normal quiescent level (set by the bias) irrespective of the fixed base current into the first. This is called a.c. coupling.

If one considers an amplifier there is obviously going to be a lower frequency limit below which the second stage will not respond. Hence to get good low frequency response in a.c. coupled amplifiers the coupling capacitor usually has to be of quite a large value.

Potentiometers

There seems to be an unlimited range of potentiometer types to choose from—carbon wirewound, log, linear, precision, ganged etc. Would it be possible for you to summarize the differences and give any hints as to what applications the different types have?

Carbon and wirewound simply describe the material used as the resistive element inside the device. On the whole wirewound devices are of better quality and are less likely to fail in use. After a lot of use the carbon tracks of composition potentiometers tend to wear away and the device becomes "noisy"; this is less likely to happen with wirewound devices.

Because there is more bulk in wirewound pots they usually have a greater power dissipation. Because they would require many turns of extremely fine wire high value wirewounds are rare (values greater than a few hundred kilohms are not common). Because they—in effect—form a coil of wire wirewound potentiometers have a significant self inductance and this precludes their use in very high frequency circuits otherwise you can always use a wirewound device to replace a carbon potentiometer.

Linear law (lin.) potentiometers are so called because the resistance between the wiper and one end is directly proportional to the amount of spindle rotation; i.e. with the spindle turned one half of a complete revolution the resistance will be exactly half the total value; a logarithmic law (log.) device does not have this proportionality—the degree of rotation is proportional to the log of the resistance. The latter are used as volume controls because the ear's sensitivity to volume also follows a logarithmic law.

Certain types of log pots are used in analogue computers (as indeed are anti-log pots) but these are usually very expensive devices because there must be an accurate relationship between the rotation and resistive value obtained; these are called precision potentiometers. They are not often used by amateurs—unless you are making a good quality signal generator or such like.

They can come as linear, log, or anti-log devices.

As the name implies, ganged potentiometers are simply two or more potentiometers coupled together on the same spindle so that they all change in value by the rotation of a single knob—most frequently come across in stereo amplifiers and Wein bridge oscillators. These can be of any law depending on the application.

Capacitor Measurement

Is there any way one can use a multimeter to measure the value of capacitors?

Unfortunately this is not possible with any degree of accuracy. The technique is to apply a known frequency signal to the capacitor and then measure its reactance with a special circuit known as a bridge. We published a capacitance bridge in our September 1972 issue (back numbers or reprints are not available).

Rectification

I would like to know what value rectifier to use to produce 9V d.c. from the mains?

To produce the voltage you require you must first reduce the value of the mains voltage with a transformer. This also gives you protection from the live mains. You then use a rectifier which must have a reverse breadown voltage in excess of the d.c. voltage you require and it must have a current rating higher than the maximum current you expect to draw.

In some instances you might need good smoothing and a capacitor might be necessary. We recommend that you watch these pages for suitable designs; we have published several in the past and there are sure to be more in the future.

Aerial and Earth

Why was it that old valve radio sets required an aerial and an earth while modern transistor radios need no earth connection?

One could write a book on the theory of radio propagation and reception so our answer will be an oversimplification of the reason. First, there is no distinction on the grounds of valves versus transistors. When a radio signal is transmitted it is made up of two components; an electrostatic signal and an electromagnetic signal. These two signals each carry the information we want to receive and we can arrange to pick up either at the front end of our radio set.

When picking up the electrostatic signal we need a long aerial which acts rather like a single plate of a capacitor—the other plate of this mythical capacitor is ground. The electrostatic signal induces charges in the aerial which flow through the tuning circuit of the radio down to the earth connection giving rise to the input signal. In many instances it is not necessary to connect the other end of the tuning circuit to a real ground because there is usually quite a high capacitative coupling anyway—nevertheless a good earth connection can make all the difference to the signal pick-up.

Before the days of ferrite aerial rods a number of portable radios used frame aerials which picked up the electromagnetic radiation from the transmitter—in just the same way that a current can be induced in a coil when a magnet is moved nearby. As technology developed we began to get magnetic materials which were efficient at the high frequencies involved and these enhanced the efficiency of the frame aerials giving rise to the ferrite aerial which is no more than a coil affected by the radiated electromagnetic energy.

No earth connection is required because the signal is totally induced within the coil, however, the orientation of the ferrite rod is important as it has to lie along the direction of the radiated lines of force for maximum signal. This occurs when the rod is horizontal and its axis is at right angles to the direction of the transmitting station.

I have recently discovered a quick and easy way of cutting Veroboard, s.r.b.p. board and almost any other type of circuit mounting board.

First rest the board you wish to cut on a hard flat surface and with a straight edge as a guide, score a deep "V" groove with a sharp glass cutter. Now rest the board on the edge of, say, a table, and give it a sharp downward blow; the board should break along the line leaving a neat sharp edge.

This method works for any type of Veroboard, tagboard or printed circuit board always giving a professional finish and doing away with the need for a hacksaw which can sometimes give a far from straight edge.

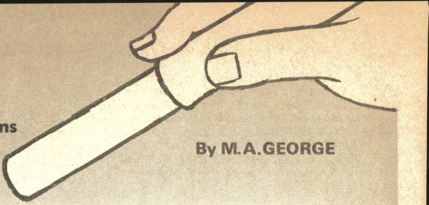
T. Holden
Northampton.

In building my *Tutor Board* for the *Teach-in '74* series I fixed the terminal blocks to the baseboard with medium size pop-rivets. These are easily removed when necessary and are, I think, an improvement on the nail method.

If the rivet shank is loose, it can easily be hammered oval.

D. Blades,
Salford, Lancs.

Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.



For simple investigations into radioactivity.

By M.A.GEORGE

RADIATION MONITOR

THIS article describes the construction and use of a portable Radiation Monitor for investigations into radioactivity in the laboratory and out of doors.

It can be used as a simple means of demonstrating the principles of radioactivity in schools (e.g. measuring penetration of β-radiation), radiation pollution monitoring and source checking.

There are also other applications for the basic circuit outside radioactivity such as testing neon lamps, and as a power supply for a battery operated oscilloscope.

The output can be fed via a Schmitt trigger to a ratemeter or decade scaler unit to form a true Geiger counter.

Despite the simplicity of the circuit, the unit is just as sensitive as any commercial one, since sensitivity depends only on the tube used, and having the correct operating voltage.

CIRCUIT

The complete circuit diagram of the unit is shown in Fig. 1 and is seen to be a Hartley Oscillator (see *Demo Circuits* Dec. '73) followed by a voltage-doubler rectification stage.

FOR GUIDANCE ONLY

ESTIMATED COST* OF COMPONENTS including V.A.T.

£5.50 excluding case

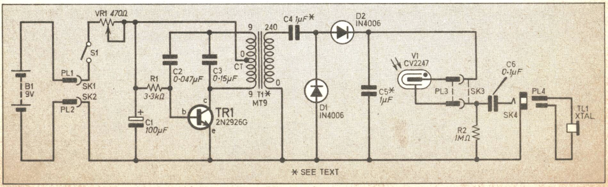
*Based on prices prevailing at time of going to press

The oscillator load is the secondary of a low voltage, low current miniature mains transformer, the secondary should not be rated at more than 100mA. The frequency of the oscillator is controlled by the choice of C3.

The bias for the oscillator is set by VR1 and positive feedback is obtained via C2 and is sufficient to overdrive TR1 to produce a clean, fast rising edge waveform for the "inverter" section of the circuit.

Due to transformer action, a voltage is induced across the primary of T1 of about 250 volts. Components D1, D2, C4 and C5 are connected to act as a voltage doubler, rectifier and smoothing stage to produce a steady d.c. level

Fig. 1. The complete circuit diagram of the Radiation Monitor.



of about 500 volts required for satisfactory operation of the Geiger tube.

The current through the tube is limited by R2 and the signal across the latter is taken via blocking capacitor C6 to the monitoring device, which in the prototype was a high impedance crystal earpiece, TL1.

Capacitors C4 and C5 must be high quality mixed dielectric types with a minimum voltage rating of 600V d.c. and diodes D1 and D2 should be rated at least 800 p.i.v.

CONSTRUCTION

The prototype unit was constructed in an aluminium box size 100 x 65 x 55mm and most of the components were mounted on the removable lid; the three bulky components, T1, C4 and C5 were secured to the base of the box. The size, shape and material (metal) of the case are not important and can be modified to suit individual requirements.

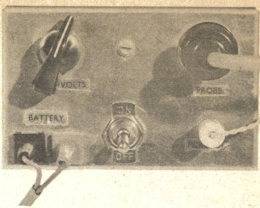
Begin construction by soldering the components to the Veroboard as detailed in Fig. 2. There are no breaks along the copper strips on the underside.

The lid should now be prepared to accept all the lid mounted components as indicated in Fig. 2. Secure these components in position and wire up to the component board as shown.

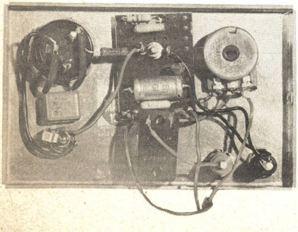
When screwing the board to the lid, a piece of foam rubber between board and lid will prevent any contact between board and case.

Two capacitor clips (or Terry clips as used in the prototype) should next be screwed to the inside base of the box to hold C4 and C5. The transformer should now be bolted or glued to the base and solder tags fitted to one of the case sides. Place C4 and C5 in position and wire up as detailed in Fig. 2.

A piece of foam rubber should be placed over the base mounted components and held in place with insulation tape before securing the lid in position. This will avoid any contact between lid and base mounted components. The controls and sockets should now be labelled as shown in the photograph.



Details of the component positioning and labelling on the top panel of the prototype.



The layout of the components and wiring on the underside of the top panel in the prototype.

Components....

SEE
SHOP TALK

Resistors

R1	3·3k Ω
R2	1M Ω

¼W ± 10% carbon

Capacitors

C1	100μF elect. 16V
C2	0·047μF
C3	0·15μF
C4	1μF mixed dielectric 600V d.c.
C5	1μF mixed dielectric 600V d.c.

Miscellaneous

VR1	470Ω carbon lin.
TR1	2N2926 green silicon *npn*
D1, 2	1N4006 or similar rated 800 p.i.v. minimum (2 off)
T1	MT9 (Osmor) or similar mains/9–0–9 80mA secondary transformer—see text
S1	s.p.s.t. toggle
VI	Geiger tube type CV2247—see text
PL1	4mm wander plug, red
PL2	4mm wander plug, black
PL3	three-pin or two-pin non-reversible plug
PL4	2·5mm jack plug
SK1, 2	4mm insulated sockets, one red, one black (2 off)
SK3	socket to suit PL1
SK4	2·5mm jack socket
TL1	crystal earpiece

Veroboard 0·15in. matrix 7 strips × 10 holes; 4BA solder tags (4 off); capacitor clips (2 off); metal case

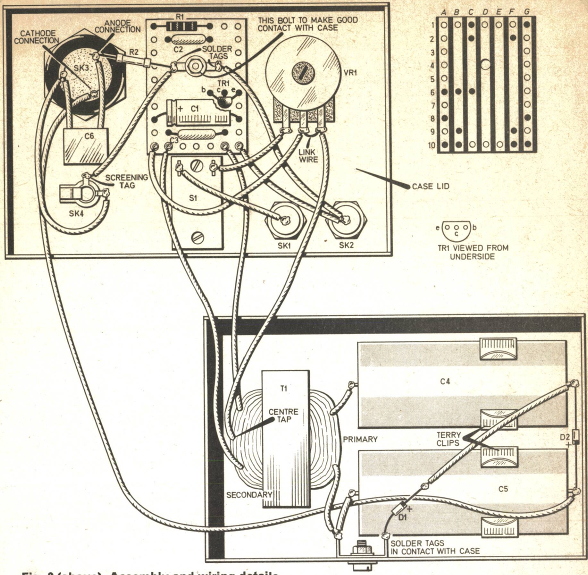
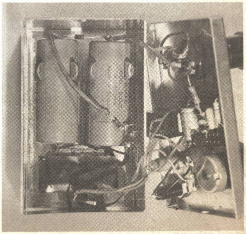


Fig. 2 (above). Assembly and wiring details within the aluminium case.

RADIATION MONITOR

Photograph (right) of the completed prototype with lid removed.



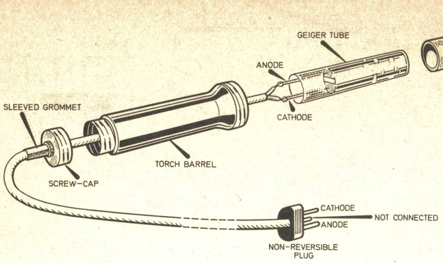


Fig. 3. Construction details for the probe.

PROBE

The probe in the prototype used a government surplus Geiger tube type CV2247 and was housed in the barrel of a torch. The tube comes complete with a sturdy rubber cover with a wire mesh window at one end for protection.

A length of twin-core mains cable should be soldered to the two terminals of the tube (brown to the anode, blue to the cathode) and fed through the torch barrel and secured there by an adhesive such as Araldite. The cable should be passed through a sleeved grommet in a hole drilled in the screw on the bottom cap, see Fig. 2.

Ensure that the wires from the tube terminals are not in contact with the inside of the torch barrel. It is a good idea to paint the torch barrel for insulation purposes.

The cable should be terminated in a two-pin non-reversible plug. In the prototype a three-pin plug and socket was used since this was at hand and the spare connector pin proved useful.

TESTING

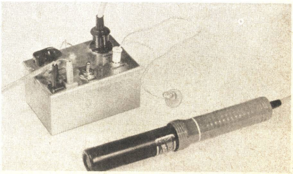
When completely satisfied with construction the unit may be tested. With S1 in the off position and VR1 set fully anticlockwise, connect the battery leads from a PP9 battery into the appropriate sockets, SK1, 2 on the lid. Insert the crystal earpiece at SK4 and plug in the probe at SK3. Switch on at S1.

A tone should be heard in the earpiece, building up after a while to a steady high pitched note. Now rotate VR1 control slowly in a clockwise direction, the pitch of the tone should gradually increase. A point will be reached where "clicks" will be heard. The number of clicks will be about 40 per minute this being due to background radiation, however these are very random—there may be periods of silence followed by bursts of clicks. This will indicate that the unit is functioning correctly.

IN USE

An increase in the number of clicks or "counts" will result if the probe is placed near a source of α or β radiation (such as the face of a luminous watch or near a TV tube) and can thus be used to compare intensity of radiation, the intensity being directly proportional to the count rate.

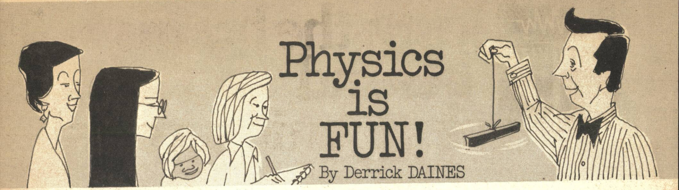
The monitoring system can take several forms, audibly via the earpiece as in the prototype, display on an oscilloscope, or via a Schmitt trigger to an analogue or digital ratemeter or decade scaler. The latter two instruments should be well known to those with a knowledge of atomic/nuclear physics. ▣



The completed unit in case with probe.

Physics is FUN!

By Derrick DAINES



THE MAGNETIC FIELD

Obtain a discarded razor-blade or hacksaw blade and holding it firmly on the table with one hand, stroke it down its full length with one pole of your magnet, see Fig. 1. At the end of the stroke, lift the magnet clear and make a wide arc to the beginning again.

Continue until either your patience or the magnet wears out. The razor-blade will now be found to be magnetised. Mark one end and suspend it by a thread. As before, the razor-blade will make an effective compass, having a north-seeking pole.

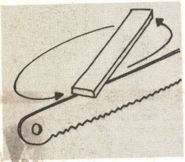


Fig. 1. Making a compass from a razor blade or hacksaw blade using a magnet.

Bring the North pole of your permanent magnet up to the North pole of the blade; the blade will spin away. Bring the North pole of the magnet up to the South pole of the blade; they will be attracted to each other.

Like poles repel—opposite poles attract.

We can compare the magnet/blade relationship with the compass/earth relationship of last month's question. When we hold the magnet in our hands, it is difficult for an outside force to turn it. Therefore, when we bring it near to the magnetised blade, it is the blade which spins away, but both have experienced the same force. Similarly with the earth; when we suspend the magnet by a thread, it reacts to the Earth's magnetic field shown in Fig. 2. Both the Earth and the magnet have experienced the same force, but it is the tiny mass of the magnet that spins, not the great mass of the Earth.

The earth is a gigantic magnet, whose magnetic field stretches many thousands of miles out into space, (Fig. 2).

The correct answer to last month's question therefore is that both the earth and the compass are active; they react to each other's magnetic field. A similar experiment to that with the iron-filings will model this more clearly.

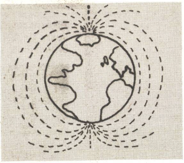


Fig. 2. The magnetic field of the earth. The lines of force are similar all the way around the equator.

Obtain a child's compass—the smaller the better. Place your magnet on the table and a sheet of paper or card over it. Now put your compass anywhere on the paper and make two marks on it opposite the ends of the compass needle. Remove the compass and join the two marks. Repeat all over the paper until the lines begin to join up into longer and longer lines, Fig. 3.

There are two things to notice: (1) The compass needle always points North/South with respect to the magnet; (2) The lines form precisely the same patterns as did the iron filings in last month's experiment. The pattern is of course two-dimensional, but if you turn your magnet over through 90 degrees of arc and repeat the experiment you will easily see that the magnetic field itself extends in all directions through space, i.e. it is three dimensional.

Magnetic fields are three-dimensional

One more experiment for this month; put your small compass in a tin—the deeper the better—and bring the magnet near to it. The compass does not respond. Why? And why did we say that the deeper the tin, the better?

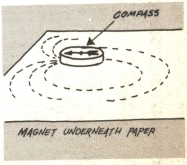
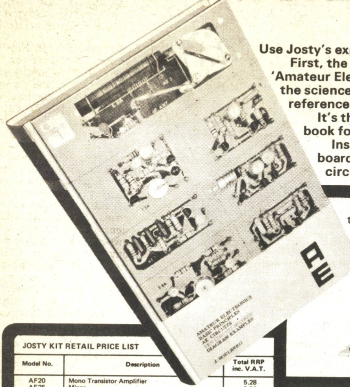


Fig. 3. Plotting the magnetic field of a magnet. This method plots the field on one plane only.

RS5

JOSTY KIT

Josty~the brains behind electronic success!



Use Josty's experience.

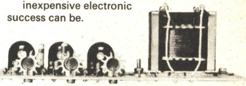
First, the background knowledge you need is in 'Amateur Electronics' – the programmed guide to the science for the beginner and a valuable reference book for the professional.

It's the nearest thing to private tuition in book form and it's only £3.30.

Inside every copy there's a free circuit board suitable for use with ten different circuits.

Among the dozens of Josty Kits—amplifiers, tuners, filters, receivers—you'll find some out-of-the-way items that are just as easy to assemble. Like the AT65 Psychedelic Light Kit, only £16 complete.

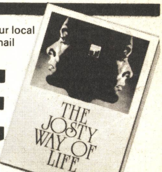
Look at the full price list and see just how inexpensive electronic success can be.



JOSTY KIT RETAIL PRICE LIST

Model No.	Description	Total RRP inc. V.A.T.
AF20	Mono Transistor Amplifier	5.28
AF25	Mixer	3.96
AF30	Mono Transistor Pre-Amplifier	2.87
AF35	Emitter Amplifier	2.50
AF80	Small 0.5 W Amplifier for Microphone	4.65
AF305	Intercom	8.28
AF310	Mono Amplifier (for Stereo use two)	6.50
M160	Multivibrator	1.88
M1302	Transistor Tester	9.30
M191	Vu-Meter	5.01
M192	Stereo Balance Meter	5.47
LF380	Quadrophonic Device	12.50
AT60	Psychedelic Light Control, Single Channel	8.58
AT65	Psychedelic Light Control, 3 Channel	16.00
AT25	Window Wiper Robot	6.40
AT30	Photo Cell Switching Unit	6.27
AT50	400w Triac Light Dimmer Speed Control	5.28
AT56	2,200w Triac Light Dimmer Speed Control	7.59
AT5	Automatic Light Control	2.84
GU330	Tremelo Unit for Guitars, etc.	8.25
HF61	Diode Detector	3.66
HF75	Frequency Modulated FM Transmitter	2.97
HF75	FM Transistor Receiver	3.16
HF310	FM Tuner Unit	17.39
HF325	De-Luxe FM Tuner Unit	26.53
HF330	Stereo Decoder for use with HF310 or HF325	10.95
GP310	Stereo Pre-Amp to use with 2, AF310	23.39
GP312	Basis Circuit Board	12.60
GP304	Basis Circuit Board	5.44
HF380	Aerial Amplifier for LW to VHF	5.54
HF395	Broadband Aerial Amplifier	1.94
NT10	Power Supply 100m/a 9V Stabilised, 12v Unstabilised	6.76
NT300	Professional Stabilised Power Supply	13.76
NT305	Voltage Converter	4.95
NT315	Power Supply 240V a.c. to 4.5 – 15V d.c. 500m/a	10.52
AE1	Output Stage 100mW	1.82
AE2	Pre-amplifier	1.39
AE3	Diode-receiver	2.20
AE4	Flasher	1.20
AE5	Astable Multivibrator	1.16
AE6	Monostable Multivibrator	1.12
AE7	RC Generator	1.17
AE8	Bassfilter	1.09
AE9	Treblefilter	1.09
AE10	CCIR – filter	1.09

All items available from your local Josty Kit stockist or from mail order addresses below.



FREE

Ask for the free catalogue, 'The Josty Way of Life'.

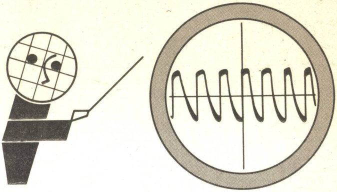
Mail Order Addresses:
Audiotronics Wholesale Ltd., Unit 4, The Hyde Industrial Estate, The Hyde, London NW9 6JJ.
Newmart Electronics, Altham House, Belmont Street, Lansdown Road, Monton, Eccles, Manchester M30 9PA.
Teleview, 414 Catcote Road, Hartlepool, Co. Durham.
Electro Spares, 288 Ecclesall Road, Sheffield S11 8PE.
Cormatronics, 12 George Street, Hastings, Sussex.
Chas. H. Young, 170 Corporation Street, Birmingham.
Channel Islands Distributor: Phoenix Electric Co. Ltd., Paragon Buildings, 6 Duhamel Place, St. Helier, Jersey and North Esplanade, Guernsey.

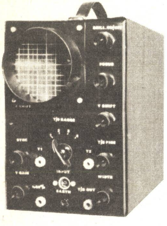
JOSTY KIT (UK) LTD (Sole UK distributors)
P.O. BOX 68, BOROUGH ROAD, MIDDLESBROUGH, CLEVELAND.

look! electronics really mastered

... practical
... visual
... exciting!

no previous knowledge
no unnecessary theory
no "maths"





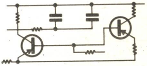
RAPY

BUILD, SEE AND LEARN
step by step, we take you through all the fundamentals of electronics and show how easily the subject can be mastered. Write for the free brochure now which explains our system.

1/ BUILD AN OSCILLOSCOPE

You learn how to build an oscilloscope which remains your property. With it, you will become familiar with all the components used in electronics.

2/ READ, DRAW AND UNDERSTAND CIRCUIT DIAGRAMS



as used currently in the various fields of electronics.

3/ CARRY OUT OVER 40 EXPERIMENTS ON BASIC ELECTRONIC CIRCUITS & SEE HOW THEY WORK, including:

valve experiments, transistor experiments amplifiers, oscillators, signal tracer, photo electric circuit, computer circuit, basic radio receiver, electronic switch, simple transmitter, a.c. experiments, d.c. experiments, simple counter, time delay circuit, servicing procedures.

This new style course will enable anyone to really understand electronics by a modern, practical and visual method—no maths, and a minimum of theory—no previous knowledge required. It will also enable anyone to understand how to test, service and maintain all types of electronic equipment, radio and TV receivers, etc.

FREE POST NOW for BROCHURE

or write if you prefer not to cut page

To: BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL,
P.O. Box 156, JERSEY. **Please send your free brochure, without obligation, to:**
we do not employ representatives

NAME BLOCK CAPS

ADDRESS PLEASE EEL 8.4.

special free gift also to all our students

SEMICONDUCTOR PRIMER

By A. P. STEPHENSON

18 ■ EXPERIMENTAL TRANSISTOR CIRCUIT

An experimental circuit to demonstrate the behaviour of a typical low-power *pnp* transistor is shown in Fig. 18.1. Component values and suitable meter ranges are given below.

Battery voltage
12 volts is suitable since nearly all transistors can withstand 12 volts between collector and emitter.

Meters
0-20mA for measurement of I_C and I_E
0-1mA for measurement of I_B
0-12V for measurement of V_C
0-1V for measurement of V_B
} meter sensitivity should be at least 20,000 ohms per volt

Resistors

VR1	1 megohm
VR2	As low as possible, e.g. 100 ohms 2 watt. This will draw 120mA from the battery.
R1	5 kilohm, this will limit the base current to a safe level if VR1 is set to zero.

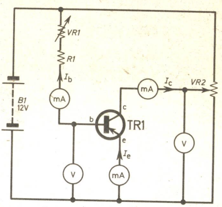


Fig. 18.2. Experimental circuit diagram used for determining some basic characteristics of a low-power *pnp* transistor.

19 ■ SIGNAL GROUND

In Fig. 19.1 point *A* is obviously 5 volts positive as far as d.c. is concerned, but as an alternating signal is concerned this point is virtually at ground because the capacitor is behaving as a short circuit to the a.c. signal.

The point *A* is said to be at SIGNAL GROUND.

As far as the value of the capacitor is concerned, its reactance X_c should be much smaller (say ten times smaller) than the resistor it bypasses.

This calculation must be carried out on the assumption that the LOWEST possible frequency is present.

If it is a reasonable "short", to say 50Hz, it will be even better at 500Hz.

Examples

(a) The d.c. supply rail in any transistor circuitry is always at signal ground (because of the large electrolytic capacitors used to smooth the supply).
(b) The emitter of Fig. 19.2 is 5 volts positive to ground as far as d.c. is concerned but is at signal ground due to the capacitor.
(c) The common-base amplifier shown in Fig. 19.3 must have the normal d.c. bias on the base but it must be held at signal ground. The capacitor takes care of this.

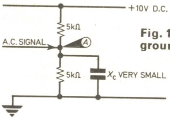


Fig. 19.1. Point A is at ground for a.c.

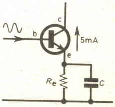


Fig. 19.2. For a.c. signals the emitter is held at ground by the capacitor.

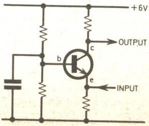


Fig. 19.3. Single-stage common-base amplifier.

DOWN TO EARTH

By GEORGE HYLTON

"Why does everybody persist in saying that current flows from positive to negative when the electrons, which make up the current, flow from negative to positive?"

The short answer, I suppose, is that not everybody does adopt the convention of positive-to-negative current flow. Some teachers use electron flow. The result is needless confusion.

In one respect the argument is absurd. This can be demonstrated by the simplest electric circuit, see Fig. 1. Here a "box" gives out a voltage (or as some pedants would say, an electromotive force). The box may contain a battery or a dynamo or a solar cell or any other kind of d.c. generator. It doesn't matter which. Let's suppose it's a battery.

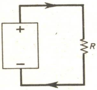


Fig. 1. Direction of arrows shows conventional current flow through R.

TWO-WAY FLOW

Conventional current flows in the direction shown, from positive to negative. Or does it? Take a closer look. The current goes round and round, through the resistance *R*, back through the battery, through the resistance . . . . and so on. Concentrate on the battery.

Conventional current in the battery does not go from positive to negative, does it? It goes from negative to positive!

So in one part of the circuit we have current going from positive to negative while in another part it goes from negative to positive. If the current consists of a stream of electrons, then it goes the "right" way inside the battery and the "wrong" way outside it.

Whichever convention you adopt it gives the wrong direction in one part of the circuit. The idea that the direction of electron flow ought to be the same as the direction of current flow must be violated in some part of any working circuit.

CURRENT CARRIERS

If the battery happens to be a lead-acid accumulator, two kinds of current carrier are at work inside it at the same time. Positive hydrogen ions move to the positive plate, while negative sulphate ions carry their charges to the negative plate. There are no free electrons involved. So the simple idea that current ought to flow the way the charges flow is, in an electrolyte, meaningless.

It's true, of course, that in electronics we are usually concerned only with the external circuit, and not with what's going on inside the power supply. It's also true that the commonest ingredient of electronic circuits, namely bits of wire or their printed or integrated circuit equivalents conduct current through the movement of electrons and only electrons. True also is that these have negative charges and so move towards the positive side of the supply line. True that this movement of electrons is in the opposite direction to conventional current.

CONTRADICTION

The reason for this contradiction lies in history. Long before the discovery of the electron, physicists were faced with the need to adopt some sort of convention for the direction of flow of the weightless, invisible substance which they called "the electric fluid". They needed a convention so as to be able to talk to one another about it. Too bad that they guessed wrong, in terms of electron movement.

By the time J. J. Thompson discovered the electron at the end of the 19th century, generations of electrical engineers had grown up and a vast amount of technology and hardware had been produced all in the convention of positive to negative flow. The price of changing the convention would have been enormous, and anyway, the motors still went round the right way, error or no error, so what difference did it make? So they did nothing.

RADIO VALVE

Things got a little tougher when the radio valve came along. Here was a device in which an electric current passed through a vacuum and there was no doubt at all—after J. J. Thompson's discovery—that the charge carriers in the valve were electrons.

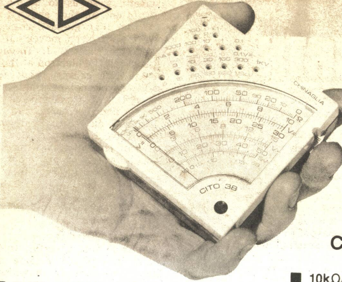
Electrons certainly moved from the negative cathode to the positive anode, the opposite direction to conventional current as indicated on a meter.

Difficult. Yet despite this glaring contradiction generations of radio engineers have managed to ply their trade without coming to grief. With the introduction of the transistor life became easier.

HOLES

In the transistor, as in the valve or the piece of wire, electrons carry the current. But for reasons of mathematical convenience transistor physicists invented a new, imaginary carrier, the positive "hole". Now, a positive hole is the space left where a negative electron has moved out. It has no real existence; it just happens to be easier, in certain circumstances, to think of positive holes moving one way than negative electrons moving the opposite way.

Never mind. If you apply the "hole" concept to an ordinary circuit like Fig. 1 then the holes move in the same direction as the conventional current—in the external circuit, of course—so there's no need to alter the convention after all. Particle motion—imaginary though the particles may be—and current direction are at one, God's in his heaven and all's right with the world.



A CITO IN THE HAND IS WORTH £10·10

INC. V.A.T.

THE TRULY POCKET MULTIMETER FROM CHINAGLIA OF ITALY

- 0·1V to 1kV f.s.d. d.c.; 5V to 1·5kV f.s.d. a.c.
- 100μA to 1A f.s.d. d.c.; 5mA to 0·5A f.s.d. a.c.
- 10kΩ/V d.c. sensitivity with 2·5% accuracy.
- Resistance 0–10kΩ and 0–1MΩ.
- Power −10 to +65dB in 6 ranges.

For further information on the "CITO" or other instruments from the exciting Chinaglia range write or telephone:

CHINAGLIA (U.K.) LTD. 19 Mulberry Walk, London S.W.3 Tel. 01-352 1897
Trade enquiries welcomed

GIRO NO. 331 7056
C.W.O. only. P. & P. 10p on orders below £5
Discount: £10–10%, £20–15% (except net items)
Export Order enquiries welcome (VAT free)

Official Orders accepted from
Educational & Government Departments
ALL PRICES INCLUDE VAT

SPECIAL RESISTOR KITS (Prices include post & packing)

10E12 ¼W KIT: 10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%), £3·65 net
10E12 ½W KIT: 10 of each E12 value, 22 ohms—1M, a total of 570 (CARBON FILM 5%), £3·85 net
25E12 ¼W KIT: 25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%), £8·35 net
25E12 ½W KIT: 25 of each E12 value, 22 ohms—1M, a total of 1425 (CARBON FILM 5%), £8·45 net
20E12 ½W KIT: 20 of each E12 value, 22 ohms—2M2, a total of 1220 (METAL FILM 5%), £11·05 net
15E12 1W KIT: 15 of each E12 value, 10 ohms—1M, a total of 915 (METAL FILM 5%), £13·35 net
10E12 2W KIT: 10 of each E12 value, 10 ohms—1M, a total of 610 (METAL FILM 5%), £17·15 net

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. Mounting: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 3½p. 0·068μF, 0·1μF, 4½p. 0·15μF, 4½p. 0·22μF, 5½p. 0·33μF, 8p. 0·47μF, 9p. 0·68μF, 12p. 1μF, 15p. 1·5μF, 23p. 2·2μF, 26p.

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, 2½p. 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, 3½p. 0·047μF, 0·068μF, 0·1μF, 4½p. 0·15μF, 6½p. 0·22μF, 8½p. 0·33μF, 12p. 0·47μF, 14p.
160V: 0·01μF, 0·015μF, 0·022μF, 3p. 0·047μF, 0·068μF, 3½p. 0·1μF, 4½p. 0·15μF, 5p. 0·22μF, 5½p. 0·33μF, 6½p. 0·47μF, 8½p. 0·68μF, 12p. 1μF, 14p.

MINIATURE CERAMIC PLATE CAPACITORS

50V: (pF) 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1K, 1K5, 2K2, 3K3, 4K7, 6K8, (μF) 0·01, 0·015, 0·022, 0·033, 0·047, 2½p. each. 0·1, 30V, 4½p.

POLYSTYRENE CAPACITORS 160V 5%

(pF) 10, 15, 22, 33, 47, 68, 100, 150, 220, 330, 470, 680, 1000, 1500, 2200, 3300, 4700, 4p. 6800, 10,000, 4½p.

RESISTORS

CF—High Stab Carbon Film, 5% MF—High Stab Metal Film, 5%.

W.	Type	Range	1–99	100–499	500–999	1000+	Size mm
⅛	CF	22–1M	1	0·75	0·60	0·55	2·4×7·5
¼	CF	22-2M2	1	0·75	0·60	0·55	3·9×10·5
½	CF	22-1M	1	0·75	0·60	0·55	5·5x16
¼	MF	10-2M7	2	1·54	1·32	1·1	3x7
½	MF	10-2M2	2	1·43	1·21	0·99	4·2x10·8
1	MF	10-10M	3	1·98	1·81	1·65	6·6x13
2	MF	10-10M	4·5	3·52	3·08	2·75	8x17·5

For value mixing prices, please refer to our catalogue. (price in pence each)
VALUES AVAILABLE—E12 Series only. (Net prices above 100.)

PRESET SKELETON POTENTIOMETERS

MINIATURE 0·25W Vertical or horizontal **6p** each 1K, 2K2, 4K7, 10K, etc. up to 1M Ω
SUB-MIN 0·05W Vertical, 100 Ω to 220K Ω **5p** each

B. H. COMPONENT FACTORS LTD.

(E.E.) 61 CHEDDINGTON ROAD, PITSTONE,
NR. LEIGHTON BUZZARD, BEDS, LU7 9AQ
Tel.: Cheddington 668446 (Std. Code 0296)
PLEASE WRITE FOR FREE CATALOGUE

Miniature Mullard Electrolytics

1·0μF	63V	6½p	68μF	63V	12p
1·5μF	63V	6½p	100μF	10V	6½p
2·2μF	63V	6½p	100μF	25V	6½p
3·3μF	63V	6½p	100μF	63V	14p
4·7μF	63V	6½p	150μF	16V	6½p
6·8μF	63V	6½p	150μF	63V	15p
10μF	16V	6½p	220μF	6·4V	6½p
10μF	25V	6½p	220μF	10V	6½p
10μF	63V	6½p	220μF	16V	8p
15μF	16V	6½p	220μF	63V	21p
15μF	63V	6½p	330μF	16V	12p
16μF	40V	6½p	330μF	63V	25p
22μF	25V	6½p	470μF	6·4V	9p
22μF	63V	6½p	470μF	40V	20p
32μF	10V	6½p	680μF	16V	15p
33μF	16V	6½p	680μF	40V	25p
33μF	40V	6½p	1000μF	16V	20p
32μF	63V	6½p	1000μF	25V	25p
47μF	10V	6½p	1500μF	6·4	15p
47μF	25V	6½p	1500μF	16V	25p
47μF	63V	8p	2200μF	10V	25p
68μF	16V	6½p	3300μF	6·4	26p

VEROBOARD	0·1	0·15
2½ × 5"	28p	28p
2½ × 3¾"	26p	19p
3¾ × 5"	32p	33p
3¾ × 3¾"	28p	28p
2½ × 1"	7p	7p
2½ × 5" (Plain)	—	14p
2½ × 3¾" (Plain)	—	12p
5 × 3¾" (Plain)	—	22p
Insertion tool	59p	59p
Track Cutter	44p	44p
Pins, Pkt. 25	10p	10p

TRANSISTORS

AC127	16½p	BC212L	12p
AC128	22p	BC213L	12p
BC107	11p	BC214L	17p
BC108	12p	OC44	18p
BC109	13p	OC71	13p
BC148	12p	OC81	16p
BC149	12p	OC170	23p
BC182L	12p	TIS43	33p
BC183L	12p	2N2926	11p
BC184L	13p	2N3702	11p

POTENTIOMETERS

Carbon Track 5K Ω to 2M Ω, log or lin. Single, **16½p** Dual Gang **46p.** Log Single with switch **26p**
Slider Pots. 10K, 100K, 500K. 30mm, **34p.** 45mm, **47p.** 60mm, **55p.**

DIODES	
IN4001	6½p
IN4002	7½p
IN4003	9p
IN4004	9½p
IN4005	12p
IN4006	14p
IN914	7p
IN916	7p
BA100	10p
OA5	42p
OA47	9p
OA81	11p
OA200	8p

PLUGS	
DIN 2 Pin	12p
3 Pin	13p
5 Pin 180°	15p
Std. Jack	14½p
2.5mm Jack	11p
Phono	5½p

SOCKETS	
DIN 2 Pin	10p
3 Pin	10p
5 Pin 180°	12p
Std. Jack	14½p
2.5mm Jack	11p
Phono	5½p

ELECTROLYTIC CAPACITORS. Tubular & Large Cans

(uF/V): 1/25, 2/25, 4/25, 4·7/10, 5/25, 8/25, 10/10, 10/50, 16/25, 22/63, 25/25, 25/50, 32/25, 50/25, 100/10, 100/25, 6½p. 50/50, 8p. 100/50, 200/25, 11p. 250/50, 18p. 500/10, 11p. 500/25, 15p. 500/50, 18p. 1000/10, 15p. 1000/25, 22p. 1000/50, 40p. 2000/10, 20p. 1000/100 90p. 2000/25, 30p. 2000/100, 95p. 2500/25, 38p. 2500/50, 62p. 3000/50, 80p. 5000/25, 66p. 5000/50, £1·10.

HI-VOLT: 4/450, 14p. 8/350, 19p. 8/450, 20p. 16/350, 22p. 16/450, 23p. 32/350, 33p. 50/250, 20p. 100/350, 60p.

METALLISED PAPER CAPACITORS

250V: 0·05μF, 0·1μF, 6p. 0·25, 6p. 0·5μF, 7½p. 1μF, 9p. 500V: 0·025, 0·05, 6p. 0·1, 6p. 0·25, 7½p. 0·5, 9p. 1000V: 0·01, 11p. 0·022, 13p. 0·047, 0·1, 15p. 0·22, 23p. 0·47, 28p.

Integrated Circuits	
μA709C	50p
μA741C	55p
μA723C	£1
ZN414	£1·32

Screened Wire, Metre	6½p
Twin Screened Wire, Metre	12p
Stereo Screened Wire, Metre	12p
Connecting Wire, All colours, Metre	2½p
Neon Bulb, 90V Wire Ended	5 for 24p
Panel Neon, 240V Red, Amber, Clear	20p

NEW KIT
5E12½W Metal Film 5% Ultra Low Noise New Resistors with full colour coding. 5 each E12 value 10ohm—1M total 305 **£2·75** Nett.

JOSTY KITS FROM ELECTRO SPARES

The Josty appointed stockists

*** ALL KITS POST FREE! * ALL PRICES INCLUDE VAT!**

It makes practical sense to invest in Josty Kits. They come complete with everything you need – all the components ready to use, including even the solder. Plus easy-to-understand, fully comprehensive instructions, and a cast-iron guarantee. Just look at the list of Josty Kits available now from Electro Spares. Remember, every price *includes VAT,* and every Kit is *post free.*

Model No.	*Josty Kit Retail Price List*	*Total RRP inc. VAT*
AF20	Mono Transistor Amplifier	5·28
AF25	Mixer	3·96
AF30	Mono Transistor Pre-Amplifier	2·87
AF35	Emitter Amplifier	2·50
AF80	Small 0·5 W Amplifier for microphone	4·65
AF305	Intercom	8·28
AF316	Mono Amplifier (for Stereo use two)	6·50
M160	Multivibrator	1·88
M1302	Transistor Tester	9·30
M191	Vu-Meter	5·01
M192	Stereo Balance Meter	5·47
LF380	Quadrophonic Device	12·50
AT60	Psychedelic Light Control, Single Channel	8·58
AT65	Psychedelic Light Control, 3 Channel	16·00
AT25	Window Wiper Robot	6·40
AT30	Photo Cell Switching Unit	6·27
AT50	400w Triac Light Dimmer Speed Control	5·28
AT56	2,200w Triac Light Dimmer Speed Control	7·59
AT5	Automatic Light Control	2·84
GU330	Tremelo Unit for guitars, etc.	8·25
HF61	Diode Detector	3·66
HF65	Frequency modulated FM transmitter	2·97
HF75	FM Transistor Receiver	3·16
HF310	FM Tuner Unit	17·39
HF325	De-Luxe FM Tuner Unit	26·53
HF330	Stereo Decoder for use with HF310 or HF325	10·95
GP310	Stereo Pre-Amp to use with 2, AF310	23·39
GP312	Basis circuit board	12·60

Plus many others.

'AMATEUR ELECTRONICS'

Specially produced by the makers of Josty Kits to give you a professional insight into the fascinating world of electronics. Written with the amateur in mind from start to finish, "Amateur Electronics" is an ideal introduction to the whole subject – from first principles to advanced electronic techniques. The price includes a circuit board for making ten Josty Kit projects. **Only £3.30.** plus 20p p & p. No VAT.

Send S.A.E. now for a free 8-page colour brochure all about Josty Kits and Amateur Electronics.

COMPONENT LISTS FOR "EVERYDAY ELECTRONICS" PROJECTS

Save money- and time- buy all your components from one source

You only need to have constructed a few projects as published in "Everyday Electronics", to know what a problem it is to get every component just when you need it. Electro Spares have devised the complete solution. Now you can get lists of all the components required for any of the projects in this issue. Just send us a stamped addressed envelope, and tell us which project you are interested in. The list shows a separate price for each item, as well as a price for the complete kit. You can buy any one or more components to suit yourself.

GUARANTEED COMPONENTS FROM ELECTRO SPARES

Every single component you buy from us is a new branded product from a reputable manufacturer. And it carries the manufacturer's full guarantee.

ELECTRO SPARES

The Component Centre of the North

288 ECCLESALL RD., SHEFFIELD S11 8PE (B)
Tel: Sheffield (0742) 668888

Trannies

4 Bush House,
Bush Fair, Harlow,
Essex.

- ★ **PRICES INCLUSIVE OF V.A.T.**
- ★ **Retail Shop open 9 to 5.30 Mon. to Sat.**
- ★ **Post & Package 15p.**

Semiconductors				2N2926	11p	IN4148	6p	200V	48p
AC126	14p	BC183	11p	2N3053	26p	IN5400	16p	400V	66p
AC127	16p	BC184	14p	2N3054	55p	IN5401	17p	**5 Amp**	
AC128	15p	BC212	13p	2N3055	49p	IN5402	19p	50V	46p
AC141K	26p	BC213	13p	2N3702	14p	IN5404	24p	100V	57p
AC142K	26p	BC214	13p	2N3703	13p	IN5406	28p	200V	66p
AC176	18p	BD131	68p	2N3704	14p			400V	77p
AC187	24p	BD132	90p	2N3705	13p			**TRIACS**	
AC188	24p	BF194	16p	2N3706	12p	**BRIDGE**		**5 Amp**	
AC187K	28p	BF195	17p	2N3707	13p	**RECTI-**		100V	33p
AC188K	28p	BF244	27p	2N3708	11p	**FIERS**		200V	55p
AD149	49p	BFY50	18p	2N3709	12p	**1 Amp**		400V	77p
AD161	38p	BFY51	18p	2N3710	12p	100V	22p	**6 Amp**	
AD162	40p	BFY52	17p	2N3711	12p	200V	24p	100V	66p
AF114	20p	MP8111	36p	2N3819	35p	600V	27p	200V	88p
AF115	20p	OC28	50p	40361	55p	**THRYIS-**		400V	99p
AF116	20p	OC36	50p	40362	55p	**TORS**		**10 Amp**	
AF117	20p	OC44	16p	40636	69p	**1 Amp**		100V	99p
BC107	13p	OC45	10p	IN914	8p	50V	29p	200V	1·32
BC108	12p	OC71	11p	IN916	8p	100V	32p	400V	1·43
BC109	13p	OC81	12p	IN4001	7p	200V	34p	**400mW**	
BC147	13p	2N706	14p	IN4002	8p	400V	44p	**ZENER**	
BC148	13p	2N1131	24p	IN4003	10p	**3 Amp**		**DIODES**	
BC149	13p	2N1132	28p	IN4004	10p	50V	39p	3·3 to 33	
BC182	13p	2N2904	20p	IN4006	15p	100V	44p	volt 11p each	

Trannies Disco Unit

Includes

- ★ DJ 100 watt discotheque amp with full mixing & PFL facilities **£94·75**
- ★ Stereo headphone with boom microphone **£9·90**
- ★ Trannies disco console with 2 Garrard SP25 Mk IV turntables **£59·00**
- ★ Pair 50 watt speakers **£47·00**

Or complete system **£189·97** carriage £5·00. Terms available no deposit £10·16 monthly for 24 months.

We stock a full range of Disco Equipment send for list, or pay a visit.

£1 BARGAIN PACKS

£1	10 Silicon *npn* power transistors (2N3055), tested/unmarked.
£1	30 Plastic FET'S, unmarked/untested. Similar to 2N3819.
£1	20 TO5 transistors *npn* 2 to 5A, untested/unmarked.
£1	20 TO18 transistors *pnp* like BC178, BC179, etc., untested/unmarked.
£1	30 Plastic 2N3055, unmarked/untested, TO220 case.
£1	10 General purpose, fully tested FET's.
£1	500 Carbon resistors, ¼, ½, 1, 2W.
£1	100 Electrolytic condensers.
£1	250 Ceramic Polystyrene, silver mica, etc., condensers.
£1	250 Polyester, Polycarbonate, paper, etc., condensers.
£1	25 Potentiometers, assorted.
£1	250 High Stab. 1%, 2%, 5% resistors.
£1	1lb Assorted nuts, bolts, washers, spacers, etc.
£1	50 Presets Potentiometers.

★ **Any 5 Packs £4·50** ★
(P/P 12p per Pack.)

We stock a large range of electronic semiconductors at competitive prices. Our new '74 catalogue is now available at 20p.

A small range from our catalogue.

Mullard Polyester Capacitors

C280 SERIES

250V P.C. mounting: 0·01μF, 0·015, 0·022 **3½p.** 0·033, 0·047, 0·068 **4p.** 0·1 **4½p.** 0·15, 0·22 **5½p.** 0·33 **7p.** 0·47 **9½p.** 0·68 **12p.** 1μF **14p.** 1·5μF **22p.** 2·2μF **27p.**

C296 SERIES

400V: 0·001μF, 0·0015, 0·0022, 0·0033, 0·0047 **3p.** 0·0068, 0·01, 0·015, 0·022, 0·033 **3½p.** 0·047, 0·068, 0·1 **4½p.** 0·15 **6½p.** 0·22 **8½p.** 0·33 **12p.** 0·47 **14½p.**

160V: 0·01μF, 0·015, 0·022, 0·033, 0·047, 0·068 **3½p.** 0·1 **4p.** 0·15 **4p.** 0·1 **4½p.** 0·15, 0·22 **5¼p.** 0·33 **7p.** 0·47 **9½p.** 0·68 **12p.** 1μF **14½p.** 1·5μF **22p.** 2·2μF **24p.**

Electrolytic Capacitors

6·3 VOLT	
68μF	6½p
150μF	6½p
470μF	11p
680μF	13p
1500μF	18p
2200μF	18p
3300μF	26p

10 VOLT	
47μF	6½p
100μF	6½p
220μF	8p
330μF	10p
470μF	10p
1000μF	11p
1500μF	20p
2200μF	24p

16 VOLT	
15μF	6½p
33μF	6½p
150μF	6½p
150μF	8p

16 VOLT	
220μF	9p
680μF	17p
1000μF	17p
1500μF	25p
2000μF	43p

25 VOLT	
10μF	6½p
22μF	6½p
47μF	6½p
100μF	8p
150μF	8p
220μF	10p
470μF	13p
680μF	20p
1000μF	22p
2200μF	39p
5000μF	68p

40 VOLT	
6·8μF	6½p
15μF	6½p
33μF	6½p

40 VOLT	
47μF	6½p
100μF	9p
68μF	10p
220μF	11p
470μF	19p
680μF	25p
1000μF	25p
2200μF	44p

63 VOLT	
1μF	6½p
2·2μF	6½p
4·7μF	6½p
6·8μF	6½p
10μF	6½p
22μF	6½p
68μF	10p
100μF	11p
150μF	13p
220μF	19p
330μF	22p
470μF	26p
1000μF	44p

VOLUME CONTROLS

Potentiometers

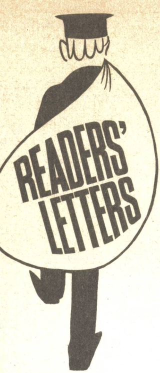
Carbon track 500Ω to 2·2M Ω. Log or Linear. Single **13p.** Dual gang (stereo) **44p.** Single type with D.P. switch **13p** extra.

RESISTORS

¼ watt 5% carbon	1p
½ watt 5% carbon	1p
1 watt 10% carbon	2½p
range 10 ohms to 4·7 megohms	
½ watt m/o 2%	4p
range 10 ohms to 1 megohms	

VEROBOARD

	0·1	0·15
2½ × 3¾	24p	19p
2½ × 5	27p	23p
3¾ × 3¾	27p	23p
3¾ × 5	31p	31p
17 × 2½	82p	63p
17 × 3¾	£1·10	87p
17 × 5 (Plain)		90p
Pin insertion tool	57p	57p
Spot face cutter	46p	46p
Pk. 36 Pins	20p	20p



Ignoramuses?

I write because I take strong exception to the comments of your columnist, Mr. Paul Young in *Counter Intelligence* in your April issue.

He (or the supplier of his material) seems to have the attitude that those who live beyond the English Channel or the Irish Sea are a bunch of ignoramuses who know nothing about the realities of life outside the jungle clearing.

Mr. Young's article is intended to give the idea that overseas customers wish to be subsidized. No wonder that this firm only gets £1,000 in overseas business a year. Has this firm ever conceived it likely that if they said to customers "You owe us £1·10" or "Please send a remittance of £2·50 to cover costs" that the customer would refuse.

Thankfully, the attitude of this firm in the home country is not shared by some others. I have dealt with a number of them that advertise in your excellent magazine and in those published by IPC Magazines and I can commend to your overseas readers Electrovalue Ltd., Arrow Electronics and Antex Ltd. to name three who are prompt in their despatch of items, are courteous and charge fair prices.

The position is not as one-sided as Mr. Young would have your readers think. There are a number of export mail-order firms that charge outrageous amounts for packaging, and no matter what quantity is added for postage etc., it is kept and no credit given.

Recently two meters that arrived in a light cardboard box surrounded by shredded newspaper cost £1 to package. Couple this with the attitude of Mr. Young's firm and can you wonder why overseas customers have now switched to other countries for their supplies?

I am afraid that besides the unguaranteed and uncertain delivery date of British products another serious casualty of world competition has been the traditional British reputation for courtesy and impeccable trade practices. But I guess that these do not balance books.

W. C. Trotman
Barbados,
West Indies.

The difficulty in answering Mr. Trotman's letter, is that he accuses me of saying or implying things I neither said nor implied. "Please re-read my article Mr. Trotman". I did not state nor imply that overseas customers were ignoramuses (or is it ignorami?), in fact I commiserated with them on their plight!!

Mr. Trotman also misses the point, which is that a small mail-order firm like ourselves cannot cope with export orders. The three firms he mentions, one is a manufacturer and two are wholesalers. They would be geared up to export anyway, so that an extra small order would not throw them and they know there is always the chance it will be followed by a big order.

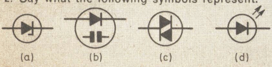
Several years ago we tried very hard to build up our export side, but our turnover never exceeded £2,000 a year and it became obvious that we should never receive any orders other than the small "one off" orders.

I do not think I would be exaggerating, if I said that even with U.K. orders we probably lose money on any order under one pound, but we regard that as part of our service because that customer returns again and again; the overseas customer rarely does! ***Paul Young.***

What do you know?

DIODES

1. A circuit you are constructing calls for a bridge rectifier of 50 p.i.v. at 1 amp. State what these ratings mean and indicate which of the following bridge rectifiers would be suitable (a) 50V, 1·5A (b) 75V 1A (c) 100V ½A.
2. Say what the following symbols represent.



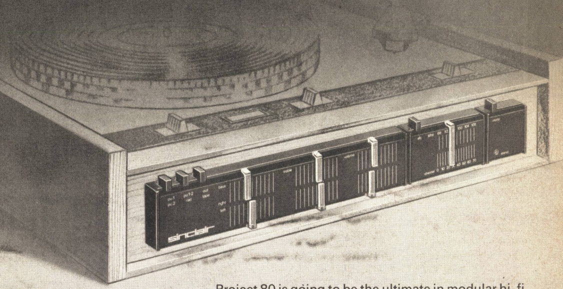
3. Indicate the anode and cathode on diagram 2a and state which end would be marked with a red band or dot or a + sign.

ANSWERS

1. The 50 p.i.v. means that the diode can stand a peak inverse voltage of 50V, i.e. the voltage is applied so that the diode is reverse biased. Both (a) and (b) would be suitable—the current rating is a maximum thus (c) would not be suitable.
2. (a) Zener diode (b) diode used as a capacitive device, e.g. varactor (c) bi-directional diode, e.g. diac (d) light emitting diode (l.e.d.).
3. The cathode is the end to which the arrow points and is normally marked with a red band or dot or a + sign.

Project 80

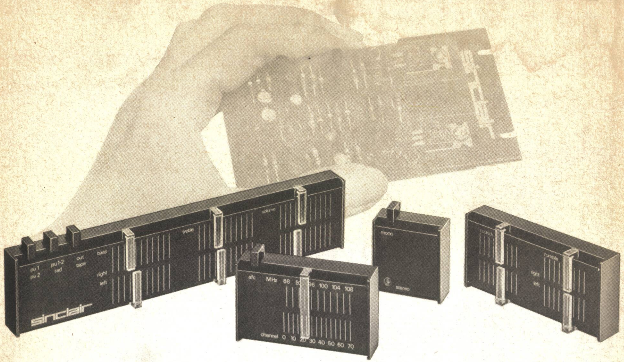
a brilliant new concept in modular hi·fi



Project 80 is going to be the ultimate in modular hi-fi construction for a very long time to come. It combines the qualities most demanded of any modern domestic system – good circuitry, reliability and fine performance – with other features to be found nowhere else in the world. For example, *compactness* – Project 80 control units are $\frac{3}{4}$″ deep × 2″ high, and each one is completely self-contained. *Elegance* – all of Sinclair's design leadership has been concentrated on producing designs of outstanding functional elegance unsurpassed for styling and simplicity. *Flexibility* – the size and styling of Project 80 modules makes them the most versatile units ever. Combine them how you will, where you will, the Project 80 System of your choice gives you the best.

sinclair

Sinclair Project 80



technically the world's most advanced

Project 80 gives you choice from a range of 9 different modules for combining in a variety of ways to suit your requirements. The Stereo 80 is a versatile pre-amp control unit designed to meet all domestic hi-fi requirements including tape monitoring, high sensitivity magnetic cartridge input, and of course, individual slide controls on each channel for precise output matching. By separating the F.M. tuner and stereo decoder, useful economies can be effected where stereo radio reception is not needed. Two power amplifiers – Z.40 (18 watts RMS continuous into 4 ohms using 35V) and Z.60 (25 watts RMS continuous into 8 ohms using 50V) are available with choice of 3 different power supply units. The PZ.8 with its virtually indestructible circuitry is particularly recommended. For the final word in system building, the Active Filter Unit puts the finishing touch of quality to what are easily the world's most technically advanced hi-fi modules. Any further units likely to be added to Project 80 range will be compatible with those already available.

Guarantee

If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair appointed stockists also offer this guarantee. Should any defect arise in normal use, we will service it without charge.

sinclair

Sinclair Radionics Ltd
London Rd., St. Ives
Huntingdon PE17 4HJ
Telephone
St. Ives (0480) 64646

Stereo 80 Control Unit Size – 260 × 50 × 20mm (10¼ × 2 × ¾ins) **Finish** – Black with white indicators and transparent sliders **Inputs** – Magnetic pick-up 3mV RIAA corrected; Ceramic pick-up 350mV Radio 100mV; Tape 30mV **Signal/noise ratio** – 60db **Frequency range** – 20Hz to 15KHz ±1dB; 10Hz to 25KHz ±3dB **Power requirements** – 20 to 35 volts **Outputs** – 100mV + AB monitoring for tape **Controls** – Press button tape radio and P.U. Sliders on each channel for volume bass treble R.R.P. (add £1·19 V.A.T.) **£11.95**

Project 80 FM Tuner Size – 85 × 50 × 20mm (3½ × 2 × ¾ins) **Tuning range Dual varicap** – 87·5 to 108MHz **Detector** – I.C. balanced coincidence **One I.C. equal to 26 transistors Distortion** – 0·2% at 1KHz for 30% modulation **4 pole ceramic filter in I.F. section Aerial impedance** – 75 Ω or 240-300 Ω **Sensitivity** – 5 microvolts for 30dB S/N ratio **Output** – 300mV for 30% modulation **Power requirements** – 25 to 35 volts (R.R.P. add £1·19 V.A.T.) **£11.95**

Project 80 Stereo Decoder Size – 47 × 50 × 20mm (1⅞ × 2 × ¾ins) **One 19 transistor I.C. Channel separation** greater than 30dB **Power requirements** – 25V **Output** 150mV per channel R.R.P. (add 74p V.A.T.) **£7.45**

Active Filter Unit Separate controls on each channel. **Size** – 108 × 50 × 20mm (4¼ × 2 × ¾ins) **Voltage gain** – minus 0·2dB **Frequency response** – 40Hz to 22KHz controls minimum **Distortion** – at 1KHz – 0·03% using 30V supply **H.F. cut off (scratch)** – 22 KHz to 5·5KHz, 12dB/oct. slope **L.F. cut off (rumble)** – 28dB at 20Hz, 9dB/oct. slope R.R.P. (add 69p V.A.T.) **£6.95**

Z.40 Power Amplifier Size – 55 × 80 × 20mm (2⅛ × 3⅛ × ¾ins) 9 transistors **Input sensitivity** – 100mV **Output** 18 watts RMS continuous into 4 Ω (35V) **Frequency response** – 30Hz-100KHz ±3dB **S/N ratio** – 64dB **Distortion** – at 10 watts into 8 Ω less than 0·1% **Power requirements** – 12 to 35 volts; built-in protection against overload. R.R.P. (add 54p V.A.T.) **£5.40**

Z.60 Power Amplifier Size – 55 × 98 × 15mm (2⅛ × 3¾ × ¾ins) 12 transistors **Input sensitivity** – 100-250mV **Output** – 25 watts RMS continuous into 8 Ω (50V). **Distortion** – typically 0·03% **Frequency response** – 15Hz to more than 200KHz ±3dB **S/N ratio** – better than 70dB Built-in protection against transient overload and short circuiting **Load impedance** – 4 Ω min. safe on open circuit R.R.P. (add 69p V.A.T.) **£6.95**

Power Supply Units **PZ.8** Stabilised. Re-entrant current limiting makes damage from overload or even direct shorting impossible. Normal working voltage (adjustable) 50V. R.R.P. **£7·98** + 79p V.A.T. Without mains transformer **PZ.6** 35V. stabilised R.R.P. **£7·98** + 79p V.A.T. **PZ.5** 30V unstabilised R.R.P. **£4·98** + 49p V.A.T.

To Sinclair Radionics Ltd. St. Ives Huntingdon PE17 4HJ

Please send post paid ____________________

____

for which I enclose Cash/Cheque for £ __________ including V.A.T. __________

Name ____________________

Address ____________________

E.E.8.

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

Type	Price p
AC107	22
AC113	20
AC115	22
AC117K	32
AC122	13
AC125	19
AC126	19
AC127	20
AC128	20
AC132	16
AC134	16
AC137	16
AC141	20
AC141K	32
AC142	20
AC142K	28
AC151	17
AC154	22
AC155	22
AC156	22
AC157	27
AC165	22
AC166	22
AC167	22
AC168	27
AC169	16
AC176	22
AC177	27
AC178	31
AC179	31
AC180	22
AC180K	32
AC181	22
AC181K	32
AC187	24
AC187K	25
AC188	24
AC188K	25
ACY17	28
ACY18	22
ACY19	22
ACY20	22
ACY21	22
ACY22	18
ACY27	20
ACY28	21
ACY29	39
ACY30	31
ACY31	31
ACT34	23
ACY35	23
ACY36	31
ACY40	19
ACY41	20
ACY44	39
AD130	42
AD140	53
AD142	53
AD143	42
AD149	55
AD161	39
AD162	39
AD161 and AD162(MP)	75
ADT140	55
AF114	27
AF115	27
AF116	27
AF117	27
AF118	39
AF124	33
AF125	33
AF126	31
AF127	31
AF139	33
AF178	55
AF179	55
AF180	55
AF181	55
AF186	55
AF239	41
AL102	72
AL103	72
ASY26	28
ASY27	33
ASY28	28
ASY29	28
ASY50	28
ASY51	28
ASY52	28
ASY54	28
ASY55	28
ASY56	28
ASY57	28
ASY58	28
ASY73	28
ASZ21	44
BC107	12
BC108	12
BC109	13
BC113	11
BC114	17
BC115	17
BC116	17
BC117	20
BC118	11
BC119	33
BC120	88
BC125	13
BC126	20
BC132	13
BC134	20
BC135	13
BC136	17
BC137	17
BC139	44
BC140	33
BC141	33
BC142	33
BC143	33
BC145	50
BC147	11
BC148	11
BC149	13
BC150	20
BC151	22
BC152	19
BC153	31
BC154	33
BC157	20
BC158	13
BC159	13
BC160	50
BC161	55
BC167	13
BC168	13
BC169	13
BC170	13
BC171	16
BC172	16
BC173	16
BC174	16
BC175	24
BC177	21
BC178	21
BC179	21
BC180	27
BC181	27
BC182	11
BC182L	11
BC183	11
BC183L	11
BC184	13
BC184L	13
BC186	31
BC187	31
BC207	12
BC208	12
BC209	13
BC212L	12
BC213L	12
BC214L	16
BC225	28
BC226	39
BC301	30
BC302	27
BC303	35
BC304	40
BC440	34
BC460	40
BCY30	27
BCY31	29
BCY32	33
BCY33	24
BCY34	28
BCY70	16
BCY71	22
BCY72	16
BCZ10	22
BCZ11	28
BCZ12	28
BD115	68
BD116	88
BD121	66
BD123	72
BD124	76
BD131	55
BD132	66
BD133	72
BD135	44
BD136	44
BD137	50
BD138	55
BD139	61
BD140	66
BD155	88
BD175	66
BD176	66
BD177	72
BD178	72
BD179	77
BD180	77
BD185	72
BD186	72
BD187	77
BD188	77
BD189	83
BD190	83
BD195	94
BD196	94
BD197	99
BD198	99
BD199	£1·05
BD200	£1·05
BD205	88
BD206	88
BD207	£1·05
BD208	£1·05
BDY20	£1·10
BF115	27
BF117	50
BF118	77
BF119	77
BF121	50
BF123	55
BF125	50
BF127	55
BF152	61
BF153	50
BF154	50
BF155	77
BF156	53
BF157	61
BF158	61
BF159	66
BF160	44
BF162	44
BF163	44
BF164	44
BF165	44
BF167	24
BF173	24
BF176	39
BF177	39
BF178	33
BF179	33
BF180	33
BF181	33
BF182	44
BF183	44
BF184	28
BF185	33
BF187	30
BF188	44
BF194	13
BF195	13
BF196	16
BF197	16
BF200	50
BF222	£1·05
BF257	50
BF258	66
BF259	94
BF262	61
BF263	61
BF270	39
BF271	33
BF272	88
BF273	39
BF274	39
BFW10	66
BFX29	30
BFX84	24
BFX85	33
BFX86	24
BFX87	27
BFX88	24
BFY50	22
BFY51	22
BFY52	22
BFY53	19
BPX25	94
BSX19	17
BSX20	17
BSY25	17
BSY26	17
BSY27	17
BSY28	17
BSY29	17
BSY38	20
BSY39	20
BSY40	31
BSY41	31
BSY95	14
BSY95A	14
Bu105	£2·20
C111E	55
C400	33
C407	28
C424	28
C425	55
C426	39
C428	22
C441	33
C442	33
C444	39
C450	24
MAT100	21
MAT101	22
MAT120	21
MAT121	22
MJE2955	95
MJE3055	62
MJE3440	55
MPF102	46
MPF104	41
MPF105	41
OC19	39
OC20	70
OC22	52
OC23	54
OC24	62
OC25	42
OC26	32
OC28	55
OC29	55
OC35	46
OC36	55
OC41	22
OC42	27
OC44	17
OC45	14
OC70	11
OC71	11
OC72	16
OC74	16
OC75	17
OC76	17
OC77	28
OC81	17
OC81D	17
OC82	17
OC82D	17
OC83	22
OC139	22
OC140	22
OC169	28
OC170	28
OC171	28
OC200	28
OC201	31
OC202	31
OC203	28
OC204	28
OC205	39
OC309	44
OCP71	48
ORP12	48
P20	55
P21	50
P346A	22
P397	46
ST140	14
ST141	19
TIS43	33
UT46	30
ZN414	£1·20
2G301	21
2G302	21
2G303	21
2G304	27
2G306	44
2G308	39
2G309	39
2G339	22
2G339A	18
2G344	20
2G345	18
2G371	18
2G371B	13
2G373	19
2G374	19
2G377	33
2G378	18
2G381	18
2G382	18
2G401	33
2G414	33
2G417	28
2N388	39
2N388A	61
2N404	22
2N404A	31
2N524	46
2N527	54
2N598	46
2N599	50
2N696	14
2N697	15
2N698	27
2N699	39
2N706	09
2N706A	10
2N708	13
2N711	33
2N717	39
2N718	27
2N718A	55
2N726	31
2N727	31
2N743	22
2N744	22
2N914	16
2N918	33
2N929	23
2N930	23
2N1131	22
2N1132	24
2N1302	16
2N1303	16
2N1304	19
2N1305	19
2N1306	23
2N1307	23
2N1308	26
2N1309	26
2N1613	22
2N1711	22
2N1889	35
2N1890	50
2N1893	41
2N2147	79
2N2148	63
2N2160	66
2N2192	39
2N2193	39
2N2194	39
2N2217	24
2N2218	22
2N2219	22
2N2220	24
2N2221	22
2N2222	22
2N2368	19
2N2369	16
2N2369A	16
2N2411	27
2N2412	27
2N2646	52
2N2711	23
2N2712	23
2N2714	23
2N2904	19
2N2904A	23
2N2905	23
2N2905A	23
2N2906	17
2N2906A	20
2N2907	22
2N2907A	24
2N2923	16
2N2924	16
2N2925	16
2N2926(G)	14
2N2926(Y)	12
2N2926(O)	11
2N2926(R)	11
2N2926(B)	11
2N3010	77
2N3011	16
2N3053	19
2N3054	51
2N3055	55
2N3391	16
2N3391A	18
2N3392	16
2N3393	16
2N3394	16
2N3395	19
2N3402	23
2N3403	23
2N3404	31
2N3405	46
2N3414	17
2N3415	17
2N3416	31
2N3417	31
2N3525	83
2N3614	74
2N3615	82
2N3616	82
2N3646	10
2N3702	13
2N3703	13
2N3704	14
2N3705	13
2N3706	13
2N3707	14
2N3708	09
2N3709	10
2N3710	10
2N3711	10
2N3819	31
2N3820	55
2N3821	39
2N3823	31
2N3903	31
2N3904	33
2N3905	31
2N3906	30
2N4058	13
2N4059	11
2N4060	13
2N4061	13
2N4062	13
2N4284	19
2N4285	19
2N4286	19
2N4287	19
2N4288	19
2N4289	19
2N4290	19
2N4291	19
2N4292	19
2N4293	19
2N5172	13
2N5294	60
2N5457	35
2N5458	35
2N5459	44
2N6211	75
2S301	55
2S302A	46
2S302	46
2S303	61
2S304	77
2S305	86
2S306	86
2S307	86
2S321	62
2S322	46
2S322A	46
2S323	62
2S324	77
2S325	77
2S326	77
2S327	77
2S701	46
40361	44
40362	50

DIODES AND RECTIFIERS

AA119	9
AA120	9
AA129	9
AAY30	10
AAZ13	11
BA100	11
BA116	23
BA126	24
BA148	16
BA154	13
BA155	16
BA156	15
BY100	17
BY101	13
BY105	19
BY114	13
BY126	16
BY127	17
BY128	17
BY130	18
BY133	23
BY164	55
BYX38/30	46
BYZ10	39
BYZ11	33
BYZ12	33
BYZ13	28
BYZ16	44
BYZ17	39
BYZ18	39
BYZ19	31
CG62 (OA91 Eq.)	6
CG651 (OA70-OA79 Eq.)	7
OA5	39
OA5SL	23
OA10	39
OA47	8
OA70	8
OA79	8
OA81	8
OA85	10
OA90	7
OA91	7
OA95	8
OA200	7
OA202	8
SD10	6
SD19	6
1N34	8
1N34A	8
1N914	7
1N916	7
1N414B	7
1S021	11
1S951	7

LINEAR I.C's—FULL SPEC.

Type No.	Price 1	25	100+
72702	50p	48p	45p
72709	35p	33p	30p
72710	45p	43p	40p
72741	40p	38p	35p
72741C	45p	43p	40p
72741P	38p	36p	34p
72748P	38p	36p	34p
SL201C	59p	45p	40p
SL701C	50p	45p	40p
SL702C	50p	45p	40p
TAA263	80p	70p	60p
TAA293	£1·00	95p	90p
TAA350A	£1·85	£1·80	£1·70
µA703C	280	26p	24p
µA709C	35p	33p	30p
µA711	45p	43p	40p

NUMERICAL INDICATOR TUBES

CD66	£1·87
GR116	£1·70
3015F Minitron	£1·50

All indicators 0·9 + Decimal point. All side viewing. Full data for all types available on request.

ZN414 .. .. .. £1·20 each
I.C. Radio Rec. incl. full cir. data.

R.T.L. LOGIC I.C's

	Price each 1–24	25–99	100 up
UL900	38p	36p	29p
UL914	38p	36p	29p
UL923	55p	51p	49p

DTL 930 SERIES LOGIC I.C's

Type	Price 1	25	100+
BP930	15p	14p	13p
BP932	16p	15p	14p
BP933	16p	15p	14p
BP935	16p	15p	14p
BP936	16p	15p	14p
BP944	16p	15p	14p
BP945	30p	28p	25p
BP946	15p	14p	13p
BP948	30p	28p	25p
BP951	70p	65p	60p
BP962	15p	14p	13p
BP9093	45p	43p	40p
BP9094	45p	43p	40p
BP9097	45p	43p	40p
BP9099	45p	43p	40p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

VOLTAGE REGULATORS
TO.3 Plastic 1·5 Amps

UA.7805. 5v. (Equiv. to MVR 5V) £1·76

UA.7812. 12v. .. .. MVR 12V) £1·76

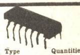
DUAL-IN-LINE SOCKETS.

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C's. TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	33p	30p	27p
TSO 16 ,, ,,	38p	35p	32p
LOW COST No.			
BPS 14	16p	14p	12p
BPS 16	17p	15p	13p

ALL PRICES INCLUDE VAT.

74 Series T.T.L. I.C's



BI-PAK STILL LOWEST IN PRICE. FULL SPECIFICATION GUARANTEED. ALL FAMOUS MANUFACTURERS

Type	Quantities 1 £ p	25 £ p	100+ £ p
7400	0·18	0·17	0·16
7401	0·18	0·17	0·16
7402	0·18	0·17	0·16
7403	0·18	0·17	0·16
7404	0·18	0·17	0·16
7405	0·18	0·17	0·16
7406	0·39	0·34	0·31
7407	0·39	0·34	0·31
7408	0·20	0·19	0·18
7409	0·20	0·19	0·18
7410	0·18	0·17	0·16
7411	0·28	0·27	0·26
7412	0·39	0·34	0·31
7413	0·32	0·31	0·30
7416	0·48	0·44	0·42
7417	0·48	0·44	0·42
7420	0·18	0·17	0·16
7422	0·55	0·53	0·50
7423	0·55	0·53	0·50
7425	0·55	0·53	0·50
7426	0·50	0·46	0·44
7427	0·50	0·46	0·44
7428	0·55	0·53	0·50
7430	0·18	0·17	0·16
7432	0·50	0·46	0·44
7433	0·75	0·73	0·70
7437	0·70	0·68	0·65
7438	0·70	0·68	0·65
7440	0·18	0·17	0·16
7441	0·74	0·71	0·64
7442	0·74	0·71	0·64
7443	1·20	1·15	1·10
7444	1·20	1·15	1·10
7445	1·98	1·95	1·90
7446	1·20	1·15	1·10
7447	1·10	1·07	1·05
7448	1·10	1·07	1·05
7450	0·18	0·17	0·16
7451	0·18	0·17	0·16
7453	0·18	0·17	0·16
7454	0·18	0·17	0·16
7460	0·18	0·17	0·16
7470	0·32	0·29	0·27
7472	0·32	0·29	0·27
7473	0·41	0·39	0·35
7474	0·41	0·39	0·35
7475	0·50	0·48	0·46
7476	0·44	0·43	0·42
7480	0·74	0·71	0·64
7481	1·30	1·25	1·20
7482	0·96	0·95	0·94
7483	1·20	1·15	1·05
7484	1·10	1·05	1·00
7485	3·50	3·30	3·30
7486	0·35	0·34	0·33
7489	4·00	3·75	3·50
7490	0·74	0·71	0·64
7491	1·10	1·05	1·00
7492	0·74	0·71	0·64
7493	0·74	0·71	0·64
7494	0·85	0·82	0·75
7495	0·85	0·82	0·75
7496	0·96	0·93	0·86
74100	1·50	1·45	1·40
74104	1·07	1·04	1·00
74105	1·07	1·04	1·00
74107	0·44	0·42	0·40
74110	0·60	0·55	0·50
74111	1·38	1·27	1·21
74118	1·10	1·05	1·00
74119	1·50	1·40	1·30
74121	0·50	0·48	0·45
74122	1·50	1·45	1·40
74123	3·00	2·90	2·80
74141	0·85	0·82	0·79
74145	1·65	1·55	1·45
74150	2·90	2·80	2·70
74151	1·10	1·05	1·00
74153	1·30	1·20	1·10
74154	1·98	1·90	1·75
74155	1·50	1·45	1·35
74156	1·50	1·45	1·35
74157	2·00	1·90	1·80
74160	2·10	2·00	1·90
74161	2·10	2·00	1·90
74162	4·40	4·15	3·85
74163	4·40	4·15	3·85
74164	2·20	2·10	2·00
74165	2·20	2·10	2·00
74166	3·20	3·10	3·00
74174	2·50	2·40	2·30
74175	1·75	1·65	1·55
74176	1·85	1·75	1·65
74177	1·85	1·75	1·65
74180	1·50	1·40	1·30
74181	5·00	4·50	4·00
74182	2·00	1·90	1·75
74184	3·20	3·10	3·00
74190	2·15	2·10	2·00
74191	2·15	2·10	2·00
74192	2·15	2·10	2·00
74193	2·15	2·10	2·00
74194	2·98	2·86	2·75
74195	2·00	1·95	1·90
74196	1·95	1·90	1·85
74197	1·95	1·90	1·85
74198	5·00	4·75	4·50
74199	5·00	4·75	4·50

Devices may be mixed to qualify for quantity price. (TTL 74 series only) data is available for the above series of I.C.'s in booklet form. Price 13p.

-the lowest prices!

BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed

Pak No.			EQVT
T1	8	2G3713	OC71
T2	8	D1374	OC75
T3	8	D1216	OC81D
T4	8	2G381T	OC81
T5	8	2G382T	OC82
T6	8	2G344B	OC44
T7	8	2G345B	OC45
T8	8	2G378	OC78
T9	8	2G399A	2N1302
T10	8	2G417	AF117

All **55p** each pak

ND 120 NIXIE DRIVER TRANSISTOR.

Suitable replacement for BSX 21, C 407, 2N 1893 120veb.

1	25	100+
0·19	**0·17**	**0·16**

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 **6p** each. Any Qty.

GP 100 TO3 METAL CASE GERMANIUM

Vebo = 80V. Vceo = 50V. I.C. = 10 amps. Ptot = 30W. hfe = 30–170. Replaces the majority of Germanium power transistors in the OC, AD and NKT range.

1	25	100+
0·48	**0·44**	**0·40**

GP 300 TO3 METAL CASE SILICON

Vebo = 100V. Vceo = 60V I.C. = 15 amps. Ptot = 115W. hfe = 20. 100fT. = 1MHz. Suitable replacement for 2N 3055, BDY 11 or BDY 20.

1	25	100+
0·55	**0·53**	**0·51**

NEW 8th EDITION
250 pages

TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalents book for European, American and Japanese Transistors. Exclusive to BI-PAK. **£1·85** each.

A LARGE RANGE OF TECHNICAL AND DATA BOOKS ARE NOW AVAILABLE EX STOCK. SEND FOR FREE LIST.

UT 46 UNIJUNCTION TRANSISTORS

Direct replacement for T1S 43rand BEN 3000 also electrically equivalent to 2N2646

1	25	100+
0·30	**0·28**	**0·22**

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8. BSY-27/28/95A.

All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p
20	For	**0·55**
50	For	**1·10**
100	For	**1·92**
500	For	**8·25**
1000	For	**14·30**

SIL. G.P. DIODES £p

300mW	30	**0·55**
40PIV(Min.)	100	**1·65**
Sub-Min.	500	**5·50**
Fully Tested	1,000	**9·90**

Ideal for Organ Builders.

R 2400 TO3 NPN SILICON HIGH VOLTAGE

Vebo = 250V. Vceo = 100V. I.C. = 6 amps. Ptot = 30W. hfe typ.20 fT = 5MHz.

1	25	100+
0·55	**0·50**	**0·44**

AD161/162

PNP

M/P COMP GERM TRANS. OUR LOWEST PRICE OF **75p** *PER PAIR.*

LOOK FOR OUR

AUDIO & ELECTRONIC COMPONENTS ADVERTISEMENTS

in PRACTICAL ELECTRONICS

RADIO CONSTRUCTOR

SILICON PHOTO TRANSISTOR. TO-18 Lens end NPN Sim. to BPX25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1-24	25-99	100 up
Price ea.	**69p**	**44p**	**38p**

QUALITY TESTED SEMICONDUCTORS

Pak No.			Price £p
Q1	20	Red spot transistors PNP	0·55
Q2	16	White spot R.F. transistors PNP	0·55
Q3	4	OC 77 type transistors	0·55
Q4	6	Matched transistors OC44/45/81/81D	0·55
Q5	4	OC 75 transistors	0·55
Q6	5	OC 72 transistors	0·55
Q7	4	AC 128 transistors PNP high gain	0·55
Q8	4	AC 126 transistors PNP	0·55
Q9	7	OC 81 type transistors	0·55
Q10	7	OC 71 type transistors	0·55
Q11	2	AC 127/128 Complementary pairs PNP/NPN	0·55
Q12	3	AF 116 type transistors	0·55
Q13	3	AF 117 type transistors	0·55
Q14	3	OC 171 H.F. type transistors	0·55
Q15	7	2N2926 Sil. Epoxy transistors mixed colours	0·55
Q16	2	GET880 low noise Germanium transistors	0·55
Q17	5	NPN 2 × ST.141 & 3 × ST.140	0·55
Q18	4	MADT'S 2 × MAT 100 & 2 × MAT 120	0·55
Q19	3	MADT'S 2 × MAT 101 & 1 × MAT 121	0·55
Q20	4	OC 44 Germanium transistors A.F.	0·55
Q21	4	AC 127 NPN Germanium transistors	0·55
Q22	20	NKT transistors A.F. R.F. coded	0·55
Q23	10	OA 202 Silicon diodes sub-min.	0·55
Q24	8	OA 81 diodes	0·55
Q25	15	IN914 Silicon diodes 75 PIV 75mA	0·55
Q26	8	OA95 Germanium diodes sub-min IN69	0·55
Q27	2	10A PIV Silicon rectifiers 1S425R	0·55
Q28	2	Silicon power rectifiers BYZ 13	0·55
Q29	4	Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·55
Q30	7	Silicon switch transistors 2N706 NPN	0·55
Q31	6	Silicon switch transistors 2N708 NPN	0·55
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·55
Q33	3	Silicon NPN transistors 2N1711	0·55
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·55
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·55
Q36	7	2N3646 TO-18 plastic 300 MHz NPN	0·55
Q37	3	2N3053 NPN Silicon transistors	0·55
Q38	7	NPN transistors 4 × 2N3703, 3 × 2N3702	0·55

ELECTRONIC SLIDE-RULE

The MK Slide Rule, designed to simplify Electronic calculations features the following scales: Conversion of Frequency and Wavelength. Calculation of L, C and fo of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and 'e' Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 22 cm × 4cm. Complete with case and instructions. Price each: **£3·69**

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Money back refund if not satisfied

Pak No.		Description	Price £p
U 1	120	Glass Sub-Min. General Purpose Germanium Diodes	0·55
U 2	60	Mixed Germanium Transistors AF/RF	0·55
U 3	75	Germanium Gold Bonded Sub-Min. like OA5, OA47	0·55
U 4	40	Germanium Transistors like OC81, AC128	0·55
U 5	60	200mA Sub-Min. Silicon Diodes	0·55
U 6	30	Sil. Planar Trans. NPN like BSY95A. 2N706	0·55
U 7	16	Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·55
U 8	50	Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·55
U 9	20	Mixed Voltages, 1 Watt Zener Diodes	0·55
U10	20	BAY50 charge storage Diodes DO-7 Glass	0·55
U11	25	PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·55
U12	12	Silicon Rectifiers Epoxy 500mA up to 800 PIV	0·55
U13	30	PNP-NPN Sil. Transistors OC200 & 2S 104	0·55
U14	150	Mixed Silicon and Germanium Diodes	0·55
U15	25	NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·55
U16	10	3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·55
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	0·55
U18	8	6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·55
U19	25	Silicon NPN Transistors like BC108	0·55
U20	12	1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·55
U21	30	AF. Germanium Alloy Transistors 2G300 Series & OC71	0·55
U23	30	MADT's like MHz Series PNP Transistors	0·55
U24	20	Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·55
U25	25	300 MHz NPN Silicon Transistors 2N708, BSY27	0·55
U26	30	Fast Switching Silicon Diodes like IN914 Micro-Min.	0·55
U27	12	NPN Germanium AF Transistors TO-1 like AC127	0·55
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CR81/25-600	1·10
U30	15	Plastic Silicon Planar Trans. NPN 2N2926	0·55
U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·55
U32	25	Zener Diodes 400mW DO-7 case 3–18 volts mixed	0·55
U33	15	Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·55
U34	30	Silicon PNP Alloy Trans. TO-5 BCY26 2S302/4	0·55
U35	25	Silicon Planar Transistors PNP TO-18 2N2906	0·55
U36	25	Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·55
U37	30	Silicon Alloy Transistors SO-2 PNP OC200, 2S322	0·55
U38	20	Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·55
U39	30	RF. Germ. PNP Transistors 2N1303/5 TO-5	0·55
U40	10	Dual Transistors 6 lead TO-5 2N2060	0·55
U41	25	RF Germanium Transistors TO-1, OC45, NKT72	0·55
U42	10	VHF Germanium PNP Transistors TO-1 NKT667, AF117	0·55
U43	25	Sil. Trans. Plastic TO-18 A.F. BC113/114	0·55
U44	20	Sil. Trans. Plastic TO-5 BC115/116	0·55
U45	7	3A SCR. TO66 up to 600PIV	1·10

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-33V.

400mV (DO-7 Case) **12p** ea. 1½W (Top-Hat) **18p** ea. 10W (SO-10 Stud) **32p** ea.

NEW LOW PRICED TESTED S.C.R.'s

PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·26	0·28	0·39	0·39	0·52	0·55	0·59	1·27
100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0 63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
600	0·59	0·63	0·75	0·75	0·85	1·07	1·38	—
800	0·70	0·77	0·88	0·88	0·99	1·32	1·65	4·40

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0 04	0·06	0·06	0·08	0·16	0·23	0·66
100	0·04	0·07	0·06	0·15	0·18	0·26	0·83
200	0·06	0·10	0·07	0·16	0·22	0·27	1·10
400	0·07	0·15	0·08	0·22	0·30	0·41	1·38
600	0·08	0·18	0·11	0·26	0·38	0·50	2·05
800	0·11	0·19	0·12	0·28	0·41	0·61	2·20
1000	0·12	0·28	0·16	0·33	0·51	0·70	2·75
1200	—	0·37	—	0·42	0·63	0·83	—

POST OFFICE TELEPHONE DIALS 60p each.

F.E.T.'S

2N3819	**31p**	2N5458	**35p**
2N3820	**55p**	2N5459	**44p**
2N3821	**30p**	BFW10	**66p**
2N3823	**31p**	MPF105	**41p**

DIACS

FOR USE WITH TRIACS.

BR100 (D32) **41p** each

TRIACS

VBOM	2A TO-5	6A TO-66	10A TO-48
	£p	£p	£p
100	33	55	83
200	55	66	99
400	77	83	1·21

CADMIUM CELLS

ORP12 **48p**

FREE

One 55p Pak of your own choice free with orders valued £4 or over

10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 99p each

INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No.	Contents	Price
UIC00	= 12 × 7400	0·55
UIC01	= 12 × 7401	0·55
UIC02	= 12 × 7402	0·55
UIC03	= 12 × 7403	0·55
UIC04	= 12 × 7404	0·55
UIC05	= 12 × 7405	0·55
UIC06	= 8 × 7406	0·55
UIC07	= 8 × 7407	0·55
UIC10	= 12 × 7410	0·55
UIC20	= 12 × 7420	0·55
UIC30	= 12 × 7430	0·55
UIC40	= 12 × 7440	0·55
UIC41	= 5 × 7441	0·55
UIC42	= 5 × 7442	0·55
UIC43	= 5 × 7443	0·55
UIC44	= 5 × 7444	0·55
UIC45	= 5 × 7445	0·55
UIC46	= 5 × 7446	0·55
UIC48	= 5 × 7448	0·55
UIC50	= 12 × 7450	0·55
UIC51	= 12 × 7451	0·55
UIC53	= 12 × 7453	0·55
UIC54	= 12 × 7454	0·55
UIC60	= 12 × 7460	0·55
UIC70	= 8 × 7470	0·55
UIC72	= 8 × 7472	0·55
UIC73	= 8 × 7473	0·55
UIC74	= 8 × 7474	0·55
UIC76	= 8 × 7476	0·55
UIC80	= 5 × 7480	0·55
UIC81	= 5 × 7481	0·55
UIC82	= 5 × 7482	0·55
UIC83	= 5 × 7483	0·55
UIC86	= 5 × 7486	0·55
UIC90	= 5 × 7490	0·55
UIC91	= 5 × 7491	0·55
UIC92	= 5 × 7492	0·55
UIC93	= 5 × 7493	0·55
UIC94	= 5 × 7494	0·55
UIC95	= 5 × 7495	0·55
UIC96	= 5 × 7496	0·55
UIC100	= 5 × 74100	0·55
UIC121	= 5 × 74121	0·55
UIC141	= 5 × 74141	0·55
UIC151	= 5 × 74151	0·55
UIC154	= 5 × 74154	0·55
UIC193	= 5 × 74193	0·55
UIC199	= 5 × 74199	0·55
UICXI	= 25 Assorted 74's	£1·65

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1·

2N3055

115 WATT SIL POWER NPN 55pEACH

2 Amp. BRIDGE RECTS.

50 v RMS	**35p**	each
100 v RMS	**40p**	,,
400 v RMS	**50p**	,,

Size 16 mm × 16 mm.

D1699 NPN SILICON DUAL TRANSISTOR

(Similar to 2N2060)

1	25	100+
0·28	**0·26**	**0·23**

B1P 19/20 TO3 NPN PLASTIC SILICON

Vebo = 100V. Vceo = 50V. I.C. = 10 amps. Ptot 50W. hfe = typ. 100 fT = 3MHz.

B1P 19/20			Matched Pair		
1	25	100+	1	25	100
0·38	0·35	0·32	0·66	0·61	0·55

Giro No. 388-7006

Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 11p. Overseas add extra for airmail.

Minimum order 55p. Cash with order please.

Guaranteed Satisfaction or Money Back

Everyday Electronics Classified Advertisements

RATES: 9p per word (minimum 12 words). Box No. 20p. extra. Semi-display—£6·00 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisement Department, "EVERYDAY ELECTRONICS," I.P.C. Magazines Ltd., Fleetway House, Farringdon Street, London EC4A 4AD.

BOOKS

We've been in a mess . . .

and I apologise publicly to every customer who suffered delays when we found there were more of you wanting our services than we were ready to deal with. There's been a reorganisation to make things quicker and easier for all of us.

By now, all our customers should have been sent copies of the new, simpler order form with the redesigned Price List. If not, would you please send a stamped addressed envelope?

DAVID McGARVA—PO Box 114—Edinburgh EH1 1HP

New customers are asked to write for a list before ordering.

RECEIVERS and COMPONENTS

LEDs. Three colours: Red, Green, Yellow. Four sizes: 0·1in, 0·125in, 0·16in, 0·2in. Mixtures all sizes and colours. 50—£5; 100—£9 including VAT and postage, CWO. Larger quantities by negotiation. Industrial Electronic Supplies (Stockport) Ltd., 181a Bramhall Lane, Davenport, Stockport, Cheshire.

3 ASS. M.C. METERS 2-3″ £1·15 (27p).
WIRE ENDED NEONS 10—50p (10p).
COPPER CLAD PAX. PANELS 5½″ × 5½″ 6—50p c.p. 7½″ × 9″ 6—£1·30 c.p.
T.V. CONVERGEANCE PANELS 2 × AC 128, 3 slugged coils, 3 slide switches, 11 w.w. pots. 3 carbon presets. 2 ferrite chokes etc. £1·10 c.p.
VALUPAKS P9 100 s/mica caps 65p c.p. Send 10p for lists of others plus panels etc. Refund on purchase.
7LB ASSORTED COMPONENTS £1·75 c.p.
2LB ASSORTED PANELS £1·75 c.p.

J. W. B. RADIO
2 Barnfield Crescent, Sale, Cheshire M33 1NL
Postage in brackets — Mail order only

EDUCATIONAL

C AND G EXAM

Make sure you succeed with an ICS home study course for C and E Electrical Installation Work & Technicians Radio/TV/Electronics Technicians. Telecommus Technicians and Radio Amateurs.

COLOUR TV SERVICING

Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV sets through new home study courses, approved by leading manufacturers.

TECHNICAL TRAINING

Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computer Engineering and Programming. Also self-build radio kits. Get the qualifications you need to succeed.

Free details from:

INTERNATIONAL
CORRESPONDENCE SCHOOLS,
Dept 731S, Intertext House, London SW8 4UJ.
Or Phone 01-622 9911

COLLEGE OF FURTHER EDUCATION, PLYMOUTH

DEPARTMENT OF ELECTRICAL ENGINEERING

PRINCIPAL: W. B. FOSTER, B.Sc., F.R.I.C., A.M.B.I.M.

The College offers Full-time Courses to those interested in a career as:

1. **RADIO, TELEVISION AND ELECTRONICS TECHNICIAN OR MECHANIC**
   Normally a two-year course, but holders of a Part 1 Certificate or equivalent are eligible for *direct entry* to the second year.
2. **MARINE RADIO AND RADAR TECHNICIAN**
   A three-year course.

Courses will commence in **SEPTEMBER 1974.**

Application forms and further details from:

The Registrar,
College of Further Education, Electrical Engineering Department, Keyham Annexe, Keyham Road, Devonport, PLYMOUTH PL2 1RE, Devon.

EXPERIMENTERS! Hundreds of unusual items cheap, list 6p. Grimsby Electronics, 64 Tennyson Road, Cleethorpes, Humberside.

VALVES. 5,000 types, 1930 to 1974. Many obsolete. SAE for quotation. List 10p. Cox Radio, The Parade, East Wittering, Sussex (West Wittering 2023).

COMPONENTS GALORE. Pack of 500 mixed components manufacturers surplus plus once used. Pack includes Resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers etc. Send £1+10p p. and p. c.w.o. to CALEDONIAN COMPONENTS, Strathore Road, Thornton, Fife.

FOR SALE

DO YOU like to dabble in electronic wizardry? Destroy the cost barrier and buy mail order. Our FREE list will open the horizon, send for it now! Chandlers of Brighton, 4 Wentworth Street, Brighton, Sussex.

MICROPHONES: AKG D109, £12·65; AKG D202E1, £43·45; AKG D190C, £18·70; AKG D190E, £20; AKG D224, £55; Sennheiser MD211N, £49·50; Sennheiser MD413N, £29·70. All brand new and boxed. Send CWO to J. J. Francis (Wood Green) Ltd., Manwood House, Matching Green, Harlow, Essex. Tel: Matching 476.

MISCELLANEOUS

PRESSURE SWITCH PADS size 8in x 21in. Suitable for your alarm systems. Price 90p each, plus postage and packing. Trade enquiries welcome. Phelmetrics, 233 Seymour Grove, Manchester M16 9QS.

GADGETS GALORE

ALARMS — TEST GEAR — GAMES — MUSICAL INSTRUMENTS — GROUP GEAR (Fuzz Boxes, etc.) — AUDIO (Preamps, 4-channel sound, amplifiers) — DISCO — SOUND EFFECTS — TIMERS. READY BUILT AND TESTED.

SAMPLE PRICE:

SIGNAL INJECTOR **£1·95**

* MAIL ORDER ONLY *

S.A.E. for List to:

G. K. SERVICES
83 Westdale Rd., London SE18 3BQ

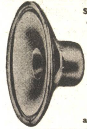
SUPERB INSTRUMENT cases by Bazelli, manufactured from heavy duty PVC faced steel, choice of 70 types, send for free list: Bazelli Instrument Cases, Dept 24, St. Wilfrid's, Foundry Lane, Halton LA2 6LT, near Lancaster.

RADIO & TELEVISION AERIAL BOOSTERS £2·95p, five television valves 45p. 50p bargain transistor packs, bargain £1 resistor and capacitor packs. UHF-VHF televisions £7·50, carr. £1·50p. S.A.E. for 3 leaflets. ELECTRONIC MAIL ORDER (BURY) LTD., Bridge Street, Ramsbottom, Bury, Lancs.

BEGINNERS, we exist for you. Instruction, components, constructional kits. Send S.A.E. to Electrolern, Lyburn Lodge, Nomansland, Wiltshire.

CONSTRUCTION AIDS. Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Fascia panels etched aluminium to individual requirements. Printed circuit boards-masters, negatives and boards, one-off or small numbers. Send 6p for list. RAMAR CONSTRUCTOR SERVICES, 29 Shelbourne Road, Stratford-on-Avon, Warks.

LOUDSPEAKERS



Speakers, kits and cabinets for D.I.Y., Hi Fi, P.A., Disco, etc. by EMI, Fane, Goodmans, Baker, Elac, Richard Allan, Wharfedale, etc. Send for free booklet "Choosing a speaker"

WILMSLOW AUDIO
Dept. H, Swan Works, Bank Square, Wilmslow, Cheshire SK9 1HF
Tel. Wilmslow 29599

FERRIC CHLORIDE
Anhydrous technical quality in sealed bags 1lb **55p** (20p), 3lb **£1·32** (30p), 10lb **£3·85** (60p).

COMPUTER PANELS
3lbs asstd. panels **£1·10** (30p), 7lb **£2·20** (40p), 56lb **£14 (£2)**. 12 high quality panels with trimpots, IC's, power transistors etc. **£2·20** (30p), 100 panels **£13** (£1). Pack of boards containing at least 500 components inc. at least 50 transistors **66p** (20p).

DEKATRON UNITS
Contain 2xCV2271 dekatrons, 2 4-digit resettable counters, 2 sealed relays, R's, c's etc. Only **£1·70** (30p).

3W TAPE AMPLIFIERS
2xECC83, EL84, EZ80 on 12 x 5 x 3″ chassis with tone and volume controls. 3 watts output to 7 x 4″ 3 Ω speaker (provided) **£2·50** (50p). Or in case 14 x 13 x 9″ with non-standard tape deck **£3·50** (£1). Suitable cassette **£1·10**, tape 75p, head 30p.

"HOT WHEELS" MODEL GARAGE
Contains 1·7V @ 1A transformer (can be modified to give up to 10V output) lamp, switch, jack plug etc. ONLY **£1·65** (30p).

7lb BARGAIN PARCELS
Hundreds of new resistors, capacitors, pots, switches, + PC boards with transistors and diodes and loads of odds and ends. Still only **£1·82** (40p). New 6 x 4″ 4 Ω speakers **£1·10 pr** (20p). 500 asstd. resistors **£1·10** (20p). 150 mica, ceramic, poly caps **66p** (14p).
All prices include VAT. SAE list, enquiries.

GREENWELD ELECTRONICS [EE5]

51 Shirley Park Rd, SOUTHAMPTON, TEL 0703 772501. Callers only at 38 Lower Addiscombe Road, Croydon.

PSYCHEDELICATESSEN

is the only way to describe the *paradise* of FREAKY gear now available from Boffin.

LOOK!

Kits	
NO LICENCE EXAM. Transmitter Receiver	£6·40
Variable-rate, BRIGHT-FLASH, Pocket Mini-Strobe	£2·40
Ready-Made Modules	
Maxi-Volt SPARK GENERATOR (½inch spark), 15,000 Volts.	£1·35
Experimental Mini DREAM-LABORATORY	£2·20
SENSITIVE non-anatomical electronic STETHOSCOPE	£2·20
Electronic 'VOICE-THROWER'	£2·20
GHOST-HUNTING AID	£2·20
PEOPLE DETECTOR	£2·20
Experimental WATER-FONE	£4·40
PSYCHEDELIC MEDITATION AID	£2·20
Bird-Watchers' REMOTE MONITOR	£2·20
Psychological CROSS-EYED EARS Device	£4·40
Super SOUND-CATCHER	£2·20

(All prices include VAT, packing & postage)

Send remittance to:

BOFFIN PROJECTS
4 Cunliffe Road, Stoneleigh,
Ewell, Surrey
(Mail order U.K. only)

Or for more details, send 20p for lists, plus free design project sheet

SERVICE SHEETS

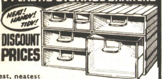
SERVICE SHEETS for over 6,000 models of Television, Radios, Transistors, Stereo, Tape Recorders, Record Players, etc., at only 30p plus S.A.E. with free Fault-Finding Guide. Over 50,000 sheets in stock for 10,000 models. S.A.E. enquiries. Catalogue 20p plus S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 429066.

WANTED

EVERYDAY ELECTRONICS' excellent Teach-in '74 for Jan., Feb., March, April, May '74. Buy or borrow. Any reasonable fee paid. Box No. 3.

"EVERYDAY ELECTRONICS" back issues required. From November '73. Double price paid. F. Burns, 125 Sandwich Close, Blackburn.

I-N-T-E-R-L-O-C-K-I-N-G PLASTIC STORAGE DRAWERS


NEAT! HANDY! TIDY!

DISCOUNT PRICES

Newest, neatest system ever devised for storing small parts and components; resistors, capacitors, diodes, transistors, etc. Rigid plastic units, interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. Build up any size cabinet for wall, bench or table top.

SINGLE UNITS (5" 2¼" 2¼") **£1·75** Dozen.
DOUBLE UNITS £3·00 Dozen.
TREBLE (3D) **£2·90** for 8.
DOUBLE TREBLE 2 drawers in one outer case (6D2) **£4·25** for 8.
EXTRA LARGE SIZE (6D1) **£3·90** for 8.

PLUS QUANTITY DISCOUNTS!
Order **£15** and over Deduct 5% in the £.
Order **£30** and over Deduct 7½% in the £.
Order **£50** and over Deduct 10% in the £.
Add 40p P. & P. to all orders under £10.
Orders over £10 P/P/C free.

Please add 10% VAT to total remittance

FLAIRLINE SUPPLIES
(Dept. EE8),
124 CRICKLEWOOD
BROADWAY, LONDON
N.W.2. 01-450 4844.

INSTRUMENTAL AUDIO EFFECTS

SUPER "FUZZ" UNIT KIT. CONNECTS BETWEEN GUITAR & AMPLIFIER. OPERATES FROM 9v BATTERY (not supplied). ALL COMPONENTS AND PRINTED CIRCUIT BOARD WITH FULL INSTRUCTIONS. KIT PRICE: £2·86 post paid.

CREATE "PHASE" EFFECT ON YOUR RECORDS, TAPES ETC., UNIQUE CIRCUITRY ENABLES YOU TO CREATE PHASE EFFECT AT THE TURN OF A KNOB. OPERATES FROM 9v BATTERY (not supplied) COMPLETE KIT OF COMPONENTS WITH PRINTED CIRCUIT BOARD & FULL INSTRUCTIONS. KIT PRICE: £2·86 post paid.

MAIL ORDER ONLY.

S.A.E. ALL ENQUIRIES.

DABAR ELECTRONIC PRODUCTS

98a, LICHFIELD STREET,
WALSALL, STAFFS. WS1 1UZ

4-STATION INTERCOM

£14.95

Solve your communication problems with this **4-Station Transistor Intercom** system (**1 master and 3 Subs**), in robust plastic cabinets for desk or wall mounting. Call/talk/listen from **Master** to **Subs** and **Subs to Master.** Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. 50p

MAINS INTERCOM NEW MODEL

No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On off switch and volume control. **Price £22·95** per pair P. & P. 60p

INTERCOM/BABY ALARM

OUR PRICE ONLY £6.50

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire and Battery. P. & P. 40p

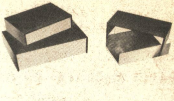
Transistor TELEPHONE AMPLIFIER

£4.95

Why not boost business efficiency with this incredible **Telephone Amplifier.** Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume Control. Complete with Battery. P. & P. 30p. Full price refunded if not satisfied in 7 days.

WEST LONDON DIRECT SUPPLIES (E/E)
169 KENSINGTON HIGH STREET, LONDON, W.8.

WELLBERRY CASES



INSTRUMENT CASES FOR THE HOME CONSTRUCTOR BLACK LEATHERGRAIN FINISHED VINYL ON STEEL COVER 20 s.w.g. ALUMINIUM BASE FRONT AND BACK UNIT.

6" x 4½" x 1¾"	18g Base	95p
8" x 5" x 2"	18g Base	£1.10p
9" x 5" x 2½"	18g Base	£1.22p
11" x 6" x 3"	18g Base	£1.44p
11" x 7½" x 3½"	16g Base	£2.15p
19" x 9" x 3½"	14g Base	£6.60p

TRADE ENQUIRIES WELCOME.
Add 15p post and packing per order.

WELLBERRY LIMITED,
(MAIL ORDER DIVISION),
24, THE SYCAMORES,
BALDOCK,
HERTFORDSHIRE

ELECTRONI-KIT

Electronic fun for all ages

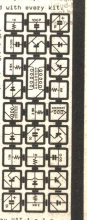
THE MOST VERSATILE ELECTRONICS KITS.

All components are beautifully encapsulated in unbreakable transparent plastic blocks. Perfect connections are made WITHOUT SOLDERING, SCREWING OR WIRING.

INCREDIBLE VALUE. Build, dismantle and rebuild projects any number of times and invent your own experiments too.

COMPLETELY SAFE, Instructive and FUN - all kits operate from 9v. battery only.

VALUABLE MANUALS included with every kit. No previous knowledge is required, even with the largest kits.



Kit 2A-30 projects £10.45
Radios, amplifiers, alarms, microphones, morse, etc.

Kit 3A-100 projects £20.45
As 2A plus electronic birds, cats, sirens, organs, metronome, guns, light and sound, burglar alarms, etc.

3ADX-105 projects £25.25
As 3A plus solar cell experiments and complete sophisticated control panel, etc.

4ADX-150 projects £33.95
As 3ADX plus Relay and Meter experiments: ion concentration-, volume-, output-, field intensity-, volt-, resistance meters, ammeter, illuminometer, etc. and many, many more.

ADD-ON parts and manuals available as required.

The three larger kits include Electrical experiments too.

All prices include Battery, VAT & p.& p.

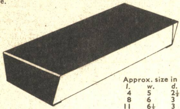
Cheque/P.O. (or 6p. for literature) to:

Satisfaction guaranteed.

ELECTRONI-KIT LTD, 408 St. John's Street, London, EC1 (01-278 4579)

PSYCHEDELIC LIGHTING UNIT IN KIT FORM
Make this fascinating three-channel unit from a kit which contains all components needed to produce an ever changing light display. Takes its drive from the speaker terminals of a record player, tape recorder or portable radio. Will drive a total of 2kW of coloured lamps at 240 volts. Supplied complete with PVC covered steel cabinet with holes ready punched for controls and cable outlets. Master control included. Coloured lamps not supplied.
Price per kit **£12·80**.

METAL CABINETS
These attractive steel cabinets are PVC covered in a range of colours, and offer an economically priced unit for the home constructor. The chassis, which has a white satin PVC finish, provides an easily accessible building area, with an integral fascia panel. The cabinet is supplied complete with stick-on feet.
Colours available include Green, Grey, Black, White and Blue. Every effort will be made to supply a selected colour, but please give alternatives if possible.



Approx. size in ins. *l.*	*w.*	*d.*	Price
4	5	2½	**75p**
8	6	3	**£1·60**
11	6½	3	**£2·04**

Other sizes to special order. HOLES PUNCHED in front or back panels to your own requirements. Please send S.A.E. for quotation.

FIXED VOLTAGE REGULATORS
TO3 case. Gives stabilised supply. MVR 5 V, MVR 12 V, MVR 15 V.
All priced at **£1·98**

SEND 5p STAMPS FOR YOUR COPY OF OUR LATEST SUPPLEMENT No. 4

D.I.L. REED RELAY

Operates direct from 5 volt TTL logic elements. Normally open contact rated at 0·25A, 100V d.c. Price each **£1·50**

Our CATALOGUE, priced at 25p post free in U.K., shows most of the R.S. range of professional components. Prices include VAT.
All orders over £1 POST FREE—U.K. only. Overseas postage at cost.
S.A.E. with all queries please.

CELECTRON-E

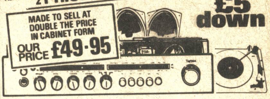
P.O. Box No. 1, Llantwit Major, Glamorgan, Wales CF6 9YN

QUALITY* STEREO SOUND

SOLENT AUDIO SYSTEM

ALMOST ½ PRICE OFFER!

£5 down



*Stereo Tuner Amplifier chassis with AM/FM radio covering long medium short and Stereo FM wavebands. Separate Base and Treble controls. Power output 7 watts R.M.S. per channel (frequency response 25-20,00 Hz) Tape record and playback facilities. Dimensions 18″ x 8½″ x 3¼″. The very latest BSR automatic record deck with cue and pause control. Two matching elliptical speaker units.

Order early limited stocks available cash price £49·95. Credit Sale £5·00 deposit 9 monthly payments of £5·75 (Total Credit price £56·75). P. & P. £2·50. Send £7·50 today.

Chassis only available for cash at £35·00.

Full 12 months Guarantee.

CALLERS WELCOME.

FREE! Stereo headphones supplied with every order.

LEWIS radio

**E.E. 8/74. 100 CHASE SIDE SOUTHGATE
LONDON N14 5PL Telephones: 01-886 9666/3733**

SPARKRITE Mk II

Electronic Ignition...

Better on all points
Because you keep your points!

The SPARKRITE MK.2 is a full capacitive discharge electronic system. Specifically designed to retain the points assembly – with **all** the advantages and **none** of the disadvantages. No misfire because contact breaker bounce is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high rpm. Contact breaker burn is eliminated by reducing the current to about 1/50th of norm, thus avoiding arcing. But you can still revert to normal ignition if need be. In seconds. If points go (very unlikely) you can get replacements anywhere. All these advantages.

●Fitted in 15 minutes. ●Up to 20% better fuel consumption. ●Instant all weather starting. ●Cleaner plugs – they last 5 times longer without attention. ●Faster acceleration. ●Faster top speeds. ●Coil and battery last longer. ●Efficient fuel burning with less air pollution.

The kit comprises everything needed

Ready drilled scratch and rust resistant case, metalwork, cables, coil connectors, printed circuit board, top quality 5 year guaranteed transformer and components, full instructions to make positive or negative earth system, and 6 page installation instruction leaflet.
WE SAY IT IS THE BEST SYSTEM AT ANY PRICE!

PRICES

D.I.Y. Kit only £11.62 incl. VAT and P & P
Ready Built Unit £14.85 incl. VAT and P & P
(Both to fit all cars with coil/distributor ignition up to 8 cylinders).
We can supply units for any petrol-engined vehicle (boat, motorcycle etc) with coil/contact breaker ignition.
Details on request. Call in and see us for a demonstration.

Order NOW direct from:—

ELECTRONICS DESIGN ASSOCIATES
(Dept EE 8) 82 Bath Street, Walsall WS1 3DE Phone 33652

THEY AMAZED US! MAYBE THEY'LL AMAZE YOU!

. . . when you read the claims made for the new pickup arm by Transcriptions of Ireland. So we checked them out. Read our test report in the interest-packed August issue of **Audio.**

ALSO

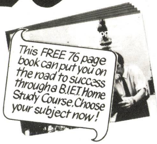
**What you need to know about FM aerials
Six top complete-system buys
Tuner/amplifiers put through their paces
Vintage loudspeakers**

Audio

AUGUST ISSUE 25p

FREE!

Practical Radio & Electronics Certificate course includes a learn while you build ***3 transistor radio kit.*** Everything you need to know about ***Radio & Electronics*** maintenance and repairs for a ***spare time income*** and a ***career*** for a better future.


This FREE 76 page book can put you on the road to success through a B.I.E.T. Home Study Course. Choose your subject now!

Over 150 ways to engineer a better future

HIGHER PAY

A BETTER JOB

SECURITY

find out how in just 2 minutes

That's how long it will take you to fill in the coupon. Mail it to B.I.E.T. and we'll send you full details and a free book. B.I.E.T. has successfully trained *thousands* of men at home - equipped them for higher pay and better, more interesting jobs. We can do as much for YOU. A low-cost B.I.E.T. home study course gets results fast - makes learning easier and something to look forward to. There are no books to buy and you can pay-as-you-learn.

Why not do the thing that really interests you? Without losing a day's pay, *you* could quietly turn yourself into something of an expert. Complete the coupon (or write if you prefer not to cut the page). No obligation and nobody will call on you . . . but it could be the best thing you ever did.

Others have done it, so can you

"Yesterday I received a letter from the Institution informing that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained – a view echoed by two colleagues who recently commenced the course".—Student D.I.B., Yorks.

"Completing your course, meant going from a job I detested to a job that I love, with unlimited prospects".—Student J.A.O. Dublin.

"My training with B.I.E.T. quickly changed my earning capacity and, in the next few years, my earnings increased fourfold" —Student C.C.P., Bucks.

FIND OUT FOR YOURSELF

These letters – and there are many more on file at Aldermaston Court – speak of the rewards that come to the man who has given himself the specialised know-how employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help *you*. **Write to B.I.E.T. Dept. BEE1, Aldermaston Court, Reading RG7 4PF.**

CUT OUT THIS COUPON

Tick or state subject of interest. Post to address below.

MECHANICAL
- Society of Engineers—A.M.S.E. (Mech.) ☐
- Institute of Engineers & Technicians (A.M.I.E.) ☐
- CITY & GUILDS Gen. Mech. Eng. ☐
- Maintenance Eng. ☐
- Welding ☐
- Gen. Diesel Eng. ☐
- Sheet Metal Work ☐
- Eng. Inspection ☐
- Eng. Metallurgy ☐

ELECTRICAL & ELECTRONIC
- Society of Engineers—A.M.S.E. (Elec.) ☐
- CITY & GUILDS Gen. Electrical Engineering ☐
- Electrical Installations ☐
- Electrical Maths ☐
- Computer Electronics ☐
- Electronic Eng. ☐
- Practical Radio & Electronics (with kit) ☐

MANAGEMENT & PRODUCTION
- Institute of Cost & Management Acctnts. ☐
- Computer Programming ☐
- Works M'ment. ☐
- Work Study ☐
- Gen. Production Eng. ☐
- Estimating & Planning ☐
- Storekeeping ☐
- Management Skills ☐
- Quality Control ☐

DRAUGHTSMANSHIP
- Institute of Engineering Designers (A.M.I.E.D.) ☐
- General Draughtsmanship ☐
- Elec. Draughtsmanship ☐
- Architectural Draughtsmanship ☐
- Technical Drawing ☐

RADIO & TELECOMMUNICATIONS
- CITY & GUILDS, Radio, TV/Electronics ☐
- CITY & GUILDS Telecoms. ☐
- Gen. Radio & TV Eng. ☐
- Radio Amateurs Exam ☐
- Radio Servicing ☐
- TV Servicing ☐
- Colour TV ☐

AUTOMOBILE & AERONAUTICAL
- Institute of the Motor Industry A.M.I.I. ☐
- MAA/IMI ☐
- CITY & GUILDS Auto Eng. ☐
- Gen. Auto Eng. ☐
- Motor Mechanics ☐
- Auto Diesel Eng. ☐
- Garage M'ment. ☐
- ARB Aero Engineering Certs. ☐
- Gen. Aero Eng. ☐

CONSTRUCTIONAL
- Society of Engineers—A.M.S.E. (Civ.) ☐
- Institute of Building—L.I.O.B. ☐
- A.B.T. Clerk of Works ☐
- Construction Surveyors Institute—L.C.S.I. ☐
- CITY & GUILDS General Building (all branches) ☐
- Heating & Vent. ☐
- Inst. Clerk of Works ☐
- Site Surveying ☐
- Health Engineering ☐
- Road Construction ☐
- Quantities, Estimates ☐
- Hydraulics ☐
- Structural Eng. ☐

GENERAL
- Agricultural Eng. ☐
- Council of Eng. Institutions ☐
- Farm Science ☐
- Plastics ☐

Supplementary courses for Nat. Certificates.

G.C.E. – choose from 58 'O' & 'A' level subjects.

Coaching for many exams, including C & G

POST TODAY FOR A BETTER TOMORROW

To B.I.E.T., Dept. BEE01 QN
Aldermaston Court, Reading RG7 4PF

BEE01

NAME ....
Block Capitals Please
ADDRESS ....
....
....
OTHER SUBJECTS ....
.... AGE ....

Accredited by C.A.C.C. *Member of A.B.C.C.*

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Published approximately the third Friday of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4 4AD. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Publisher's Subscription Rate (including postage): For one year to any part of the world £2·95. Everyday Electronics is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than tne recommended selling price shown on the cover, and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

Henry's

DON'T RELY ON YOUR MEMORY
BUY NOW AT BARGAIN PRICES
Hi Fi and Transistors – Up to date
Brochures on request

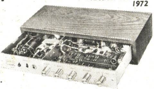
HENRY'S CATALOGUE
Due to rapid price changes, shortages of paper and raw materials, all prices in the existing catalogues no longer apply. Call or phone for latest prices. A new catalogue will be available for Aug/Sept.1974.

BUILD THE TEXAN

20 + 20 WATT IC STEREO AMPLIFIER

As featured by Practical Wireless 1972

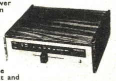
Now built and used by thousands of satisfied customers. Features slim design overall size in cabinet 15¼" x 2¾" x 6⅞". 6-IC's, 10 transistors, stabilisers Gardners low field transformer. Fibre Glass PC Panel, complete chassis work. Now available built and tested as well as in kit form. HIGH QUALITY & STABILITY ARE PREDOMINATE FEATURES — DEVELOPED BY TEXAS ENGINEERS FOR PERFORMANCE, RELIABILITY AND EASE OF CONSTRUCTION. FACILITIES. On/off switch indicator, headphones socket, separate treble, bass, volume and balance controls, scratch and rumble filters, mono/stereo switch, input selector; Mag. P.U., Radio Tuner, Aux. Can be altered for Mic., Tape, Tape-head, etc. Constructional details Ref. No. 21 **30p.** Distributed by Henry's throughout UK. FREE—Teak cabinet with complete kit.



Kit price **£28·50** (+VAT+**50p** carr/packing) or built and tested **£35·00** (+ VAT + **50p** carr/packing) as illustrated.

BUILD THE NEW HENELEC STEREO FM TUNER

A completely new high stability stereo FM tuner. Features variable capacity diode tuning, stabiliser power supply, IC Decoder, high gain low noise. IF stages. LED indicators. Tuning meter, AFC, easy to construct and use. Mains operated. Slim modern design with fibre glass PC, teak cabinet, etc. Available as a kit to build or ready built. Overall size 8" x 2¾" x 6⅛". Produced to give high performance with a realistic price. (Parts list and constructional details Ref. No. 5 30p). Henry's are sole distributors UK and Europe.



KIT PRICE **£21·00** (+ VAT) or built and tested **£24·95** (+ VAT)

EARN YOURSELF EASY MONEY, WITH PORTABLE DISCO EQUIPMENT

DISCO MINI A complete portable disco, fitted mixer/preamp, 2 decks all facilities.	**£98·50**
As above but with Slider Controls	**£118·50**
100 watt amplifier for above	**£49·50**
SDLS 100 watt mixer/amplifier with slider controls	**£69·00**
R50 50 watt mixer/amplifier	**£49·50**
R100 100 watt mixer/amplifier	**£57·50**
DISCO AMP 100 watt mixer/amplifier	**£73·00**
Northcourt:	
400 40 watt mixer/amp	**£37·50**
800 80 watt mixer/amp	**£45·00**
DISCO MIXER/PREAMPLIFIERS (OP for up to 6-100 watt amplifiers)	
SDLI (rotary controls)	**£49·50**
SDLII (slider controls)	**£58·50**
DISCO VOX (slider controls) the complete disco preamp	**£72·00**
DJ100 100 watt power amplifier for above	**£49·50**
DJ30L Mk II 3 channel 3kw sound to light	**£36·00**
DJ30L Mk III slider controls	**£45·50**
DJ DISC LITE as 30L-2 plus variable speed flashes	**£54·00**
Carlsboro Reverberation Unit	**£44·00**
Disco anti-feedback microphone	**£11·95**
Colt 150 watt liquid wheel projector	**£23·50**
150 watt QI liquid wheel projector	**£50·00**
150 watt QI cassette wheel projector	**£50·00**
Spare Effects and liquid cassettes large range of patterns	**£6·00**
6 inch Liquid wheels	**£5·00**
Various cassettes	**£6·00**
Mini spot bank fitted 3 lamps	**£12·95**
Auto Trilite (mini with flashers)	**£17·00**
Bubblemaker with liquid	**£22·50**

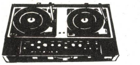
MIXERS/MICS/SPEAKERS/LIGHTING U.K.'s largest range of Disco Lighting. FREE STOCK LIST REF. No. 18 ON REQUEST.

AKG / RESLO / DJ / CARLSBORO / EAGLE MICS., STANDS, MIXERS, CABINETS. CHASSIS AND COMPLETE SPEAKER SYSTEMS, MEGAPHONES, TURNTABLES, PUBLIC ADDRESS COMPONENTS.

CERAMIC FILTERS

10·7 MHz Ceramic filters now in stock **40p** per pair.

All prices carr. paid (UK) (VAT EXTRA) Barclaycard/Access call, write or phone your order 01-723-6963—easy terms for callers.



EXCLUSIVE DECCA KELLY SPEAKERS

12 watt speaker Tweeter systems. 8" Bass/Midrobe and Melinex Domed HF radiator plus crossover **£12·50** per pair of systems (carr./packg. 40p) or built into veneered cabinets, size 18 x 12 x 6½" **£19·50** pair (carr. £1).

HI-FI TAPE EQUIPMENT

U.K.'s largest range with discounts and demonstrations for callers. Latest stock lists on request (Ref. No. 17). Phone 01-402-4736 for Barclay/Access Card. Direct orders and latest prices.

TRANSISTORS/SEMI-CONDUCTORS

U.K.'s largest range for every application. Small quantity discounts. Also Trade, Export and Industrial enquiries invited. Latest stock list (Ref. No. 36) including valves on request.

JOSTY KITS

NOW IN STOCK

Latest stock list
Ref 11 on request

NEW SINCLAIR PROJECT 80

Stereo PreAmplifier	**£11·95**
Audio Filter Unit	**£6·95**
Z40 15 Watt Amplifier	**£5·45**
Z60 25 Watt Amplifier	**£6·95**
PZ5 Mod. for 1 or 2 Z40	**£4·98**
PZ6 Mod. (S Tab) 1 or 2 Z40	**£7·98**
PZ8 Mod. (S Tab) 1 or 2 Z60	**£7·98**
TRANSFORMER FOR PZ8	**£3·95**
NEW FM TUNER	**£11·95**
STEREO DECODER	**£7·45**

All items post paid.

LIVING SOUND LOW NOISE TOP QUALITY CASSETTES MADE BY EMI TAPES LTD. TO INTERNATIONAL STANDARDS ESPECIALLY FOR HENRY'S. ALL POST PAID LESS THAN ½ REC. PRICES COMPLETE WITH LIBRARY CASES

	3 for	6 for	10 for	25 for
C 60	**£1·10**	**£1·98**	**£3·00**	**£7·40**
C 90	**£1·46**	**£2·80**	**£4·60**	**£11·25**
C 120	**£1·80**	**£3·45**	**£5·45**	**£13·45**

Quantity and trade enquiries, invited

LEARN A LANGUAGE—complete with phrase book. German — French — Spanish — Italian **£1·36** per course. **£5** for any 4.

LOW COST HI-FI SPEAKERS

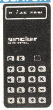
SPECIAL OFFERS

EMI 13" x 8"—full range speakers (post 20p each or 30p pair)
*150TC—8 ohms Twin Cone 10 watt **£2·20** each or **£4·00** pair.
*450 10 watt C/o Twin Tweeters 3, 8 or 15 ohms **£3·85** each
EW 15 watt 8 ohms C/o Tweeter **£5·25** each or **£7·40** per pair
350 20 watt C/o Tweeters 8 or 15 ohms **£7·80** each
* Polished wood cabinet **£4·80** post 35p.

8 ohms full range (post 20p)			
FR4	4"	5 watt	**£4·75**
FR65	6½"	10 watt	**£6·30**
FR8	8"	15 watt	**£8·50**
FR23	9 x 6"	15 watt	**£8·40**
BASS & MID RANGE—8 ohms (post 20p)			
AA12	5"	15 watt	**£3·75**
B110	5½"	15 watt	**£7·20**
B200	8"	15 watt	**£8·50**
B139/2	13" x 8"	30 watt LF	**£13·75**
TWEETERS AND CROSSOVERS (post 20p)			
K2006	10 watt	8 or 15 ohms	**£2·10**
FHT6	15 watt	8 ohms	**£3·35**
K2011	30 watt	8 ohms	**£4·80**
T27	KEF		**£5·50**
Axcent 100	30 watt	8 ohms	**£5·52**
K4009	1kHz/5kHz C/o		**£2·70**
SN75	3kHz var. C/o		**£3·10**
SPEAKER KITS (carr. etc. 35p)			
20-2	8"	30 watt	**£24·50** pair
20-3	8"	40 watt	**£35·95** pair
LINTON 2		20 watt	**£18·30** pair
GLENDALE 3		30 watt	**£32·95** pair
DOVEDALE 3		50 watt	**£51·50** pair
KEF KK2			**£55·00** pair
KEF KK3			**£78·00** pair

BUILD YOURSELF A POCKET CALCULATOR

A complete kit, packaged in a polystyrene container and taking about 3 hours to assemble—thats the Sinclair Cambridge pocket calculator from Henry's. Some of the many features include interface chip, thick-film resistor pack, printed circuit board, electronic components pack. Size 4½" long x 2" wide x 1⅛" deep.
Free of charge with the kit for the more advanced technologist is a 32-page booklet explaining how to calculate Logs. Tangents. Sines etc.



SPECIAL OFFER **£13·60** + VAT. Also available assembled ready to use. **£19·95** + VAT.

10% VAT to be added to all orders. Export supplied. Prices and descriptions correct at time of proof. Subject to change without notice. E & O E. ALWAYS BARGAINS FOR CALLERS.

See page 424 of this magazine

Henry's RADIO LIMITED
EDGWARE ROAD, LONDON W2

404-406 Electronic Components and Equipment 01-402 8381
309 PA – Disco – Lighting High Power Sound 01-723 6963
303 Bargains Store (Callers only)
Home and Car Entertainment Centres. London and branches now open.
120 Shaftesbury Avenue, London W1 01-437 9692
104 Burnt Oak Broadway, Burnt Oak, Edgware 01-952 7402
190-194 Station Road, Harrow, Middlesex 01-863 7788/9
354-356 Edgware Road, London W2 01-402 5854/4736

All mail to
303 Edgware Road,
London W2 1BW

All stores open 9 am to 6 pm six days a week
Hi-Fi - Tape Equipment Discount Stock List Free at all stores

ADCOLA

meet the precision
'INVADER' SOLDERING INSTRUMENTS

Precision instruments supplied with standard detachable copper chisel face bits. Standard temp. 360°C at 19/23/27 watts. Special temps. from 250°C/410°C.

For perfection in soldering

L1076
BIT SIZE 1/4"
6.34 mm Dia.
27 watts.
£2·18

L646
BIT SIZE 3/16"
4.75 mm Dia.
23 watts.
£2·12

L706 →
BIT SIZE 1/8"
3.2 mm Dia.
19 watts.
£1·96

Don't take chances. We don't. All our ADCOLA Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get good service ... reliability... from our famous thermally controlled ADCOLA Element and the tough steel construction of this production tool. ADCOLA day after day.

Send for NEW catalogue today

ADCOLA PRODUCTS LTD. ADCOLA HOUSE GAUDEN ROAD LONDON, SW4 6LH
Postage, packing paid on orders over £2. under £2. add £0·10

Models required ______________________
Enclosing P/O or cheque for ______________________
Name
Address

EE7

Are you alright for Jacks?

Ask for Rendar Jack plugs and sockets at your local stockist. They come in a wide variety of configurations, and in cases of difficulty can be ordered DIRECT from the Rendar factory.

Standard, mini and sub-miniature sizes . . . plugs in both screened and unscreened versions . . . socket bodies in high melting point thermoplastic . . . several unique features (some protected by UK and US Patents) . . . Post Office and NATO specifications.

If you want to study all the facts and figures, all the ingenious construction details, send for the Rendar Electronic Components Catalogue of technical data sheets covering their entire range of products.

The cost of the catalogue is 25p, including P & P, and it's money very well spent!

COMPONENTS FOR LAND, SEA & AIR

RENDAR®

Rendar Instruments Ltd., Victoria Road
Burgess Hill, Sussex. Tel. Burgess Hill 2642-4
Cables: Rendar, Burgess Hill

GIANT POWER MULTI-WAVEBAND BROADCAST RECEIVER
WITH 3 in 1 AC/DC POWER SUPPLY SYSTEM
MAINS/BATTERY plus BUILT-IN BATTERY BOOSTER

BEST OF ALL WORLDS
VHF, FM, AM, AFC, AIR BAND, PUBLIC SERVICE AND WEATHER BANDS
BATTERY CHECK INDICATOR

OUR PRICE +40p P. & P. £10·50

THIS NEW 1972 RADIO. No less than **3 VHF BANDS.** Picks up **Aircraft Transmissions, Pop Pirates, Taxis, Ambulances, Local Radio, Continental and all BBC, VHF Stations plus fascinating Public Service Transmissions we are not allowed to mention! Even TV sound in certain areas. PLUS A SPECIAL WEATHER-BAND.** Frequency ranges: MW540–1600 KHZ, FM88–108MHZ, Airband 108–145 MHZ, VHF 145–175MHZ, 23 semi-conductors—12 transistors, 11 diodes and thermistors. Automatic frequency control. 31″ telescopic aerial. Runs off mains AC 230/250 volts or off 4 U11 batteries, or use re-chargeable nickel alkali cell. Finished in strong leather grained case with carrying handle. Approx. size 10¾″ × 6⅝″ × 3¾″. Written guarantee. **Special magnetic ear-piece for personal listening, dry batteries FREE. HURRY!** Limited quantity from Sonic Sound. **Fully guaranteed.**

OUR PRICE £28·95 +50p P. & P.

8 WAVEBANDS AND WORLD MAP & TIME ZONE DIAL

Tune into the world with this amazing world radio. A truly exceptional unit in performance and looks—leatherette with stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220–240 volt domestic mains supply. 14 Transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the **8 WAVEBANDS.** Complete with Hi-Fi earphone for personal listening. Frequency ranges: **Long wave** 150–350Kcs. **Medium** 353–1605Kcs. **Marine** 1·6–4·5Mcs. **Short Wave** 12–24Mcs. **FM/VHF** 88–108Mcs. **Aircraft** 108–135 Mcs. **PUBLIC SERVICE BANDS** 135–174Mcs. Fully guaranteed.

N.B.—The Ministry of Post & Telecommunications has pointed out that a licence (not generally available to the public) is required for reception of transmissions by Fire Brigade, Aircraft, Shipping, etc.

SONIC SOUND AUDIO LTD. (Dept. ED8), **372 EDGWARE ROAD, LONDON, W.2. Tel. 01-723 0094.**
Callers welcome Monday to Saturday 9 a.m.–6 p.m.